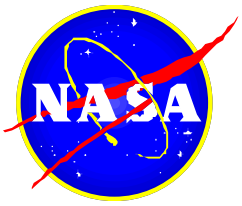

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77

December 2002

Hardware Requirements Document (HRD)
for the
Human Research Facility (HRF)

MARES Integration, Deployment, Assembly and Stowage (MIDAS)

CCB CONTROL

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for the
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MARES Integration, Deployment, Assembly and Stowage (MIDAS)

APPROVED:	**EB/E. BAUER** **TECHNICAL MANAGER**
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Preface

This Hardware Requirements Document (HRD) defines the minimum set of requirements for the MIDAS to be placed on the International Space Station (ISS). This document is under the control of the HRF Configuration Control Board (CCB).

_____

HRF CCB Chair DATE

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ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ADP	Acceptance Data Package
A	Ampere
APM	Attached Pressurized Module
Ar	Argon
ARIS	Active Rack Isolation System
ATT	Acceptance Thermal Test
AVT	Acceptance Vibration Testing
C&DH	Command and Data Handling
CAM	Centrifuge Accommodation Module
CCB	Configuration Control Board
CCSDS	Consultative Committee for Space Data Systems
CFU	Colony Forming Units
CIL	Critical Items List
cm	centimeters
CO2	Carbon Dioxide
COTS	Commercial Off-the-Shelf
dB	Decibels
dBA	Acoustic Decibel Level
DC	Direct Current
dia	diameter
DR	Discrepancy Report
DRDs	Data Requirements Documents
EEE	Electrical, Electronic, and Electromechanical
EIA	Electronic Industry Association
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPCE	Electrical Power Consuming Equipment
EPS	Electrical Power System
ESA	European Space Agency
ESD	Electrostatic Discharge
EVA	Extravehicular Activity
EWACS	Emergency Warning and Caution System
EXPRESS	EXpedite the PRocessing of Experiments to Space Station
fc	footcandle
FDS	Fire Detection Support
FEM	Finite Element Model
FIAR	Failure Investigation Analysis Report
FMEA	Failure Modes and Effects Analysis

ACRONYMS AND ABBREVIATIONS

FPD	Flight Projects Division
FSS	Fluid System Servicer
ft	feet
g	Gravity
GFCI	Ground Fault Circuit Interrupter
GHz	Gigahertz
GIDEP	Government and Industry Data Exchange Program
GN2	Gaseous Nitrogen
GPVP	Generic Payload Verification Plan
GSE	Ground Support Equipment
He	Helium
hr	Hour
HRD	Hardware Requirements Document
HRDL	High Rate Data Link
HRF	Human Research Facility
HRP	Human Research Program
Hz	Hertz
I/F	Interface
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
IMS	Inventory Management System
in	inch
ISIS	International Subrack Interface Standards
ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
IVA	Intravehicular Activity
JEM	Japanese Experiment Module
JSC	Johnson Space Center
kg	Kilogram
kHz	Kilohertz
kPa	KiloPascal
KSC	Kennedy Space Center
LAN	Local Area Network
lb	pound
lb-s	pound-second
lbf	pounds force
LRDL	Low Rate Data Link

m/s	Meters Per Second
mA	Milliamperes
MARES	Muscle Atrophy Research and Exercise System
max	Maximum
MDM	Multiplexer-Demultiplexer Module
MDP	Maximum Design Pressure
MHz	Megahertz
MIDAS	MARES Integration, Deployment, Assembly and Stowage
MIL-ER	Military Established Reliability
min	minute
mm	millimeter
mm Hg	Millimeters of Mercury
MPLM	Mini Pressurized Logistics Module
MRDL	Medium Rate Data Link
ms	Milliseconds
MSFC	Marshall Space Flight Center
MTL	Moderate Temperature Loop
MUA	Material Usage Agreement
mV	millivolt
MO	megaohm
N	Newton (metric force measurement)
N-s	Newton-second
N/A	Not Applicable
N_2	Nitrogen
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
nF	nanofarad
NSTS	National Space Transportation System (Do not use—use SSP)
NTSC	National Television Standards Committee
O_2	Oxygen
Oct	Octave
ORU	Orbital Replacement Unit
oz	ounce
P/L	Payload
Pa	Pascal
PAH	Payload Accommodation Handbook
PDA	Pre-Delivery Acceptance
PFE	Portable Fire Extinguisher
PHTR	Packaging, Handling, and Transportation Records
PIA	Payload Integration Agreement

PIP	Power Interface Panel
PRD	Program Requirements Document
psi	pounds per square inch
psia	pounds per square inch absolute
PSRP	Payload Safety Review Panel
PUL	Portable Utility Light
QAVT	Qualification for Acceptance Vibration Testing
QERM&L	Qualified EEE Parts, Manufacturers, and Laboratories
QMS	Quality Management System
QTT	Qualification Thermal Test
QVA	Qualification Vibration Analysis
Rad	Radiation Absorbed Dose
RHA	Rack Handling Adapter
RMA	Rack Mounting Adapter
rms, RMS	Root Mean Square
RPC	Remote Power Controller
RSP1SS	Resupply Stowage Platform 1 Stowage System
RSS	Root-summed square
SD	Standard Deviation
SE&I	Systems Engineering and Integration
sec	second
SEE	Single Event Effect
SIR	Standard Interface Rack
SOW	Statement of Work
SPL	Sound Pressure Level
SSPC	Solid State Power Controller
SUP	Standard Utility Panel
TBD	To Be Determined
TBE	Teledyne Brown Engineering
TBR	To Be Resolved
TCS	Thermal Control System
TIA	Telecommunications Industry Association
TM	Technical Memo
TPS	Task Performance Sheet
UIP	Utility Interface Panel
UOP	Utility Outlet Panel
USL	United States Lab
V	Volts

VC-S	Visibly Clean - Sensitive
Vdc, VDC	Volts Direct Current
VDS	Verification Data Sheet
VES	Vacuum Exhaust System
VIF	Vibration Isolation Frame
Vrms	root-mean square voltage
VRS	Vacuum Resource System
WSTF	White Sands Test Facility
^{o}C	Degrees Celsius
^{o}F	Degrees Fahrenheit
O	ohm
π	pi
µA	microampere
µsec, µs	Microsecond

1.0 SCOPE

This specification defines the Human Research Facility (HRF) program requirements for MARES Integration, Deployment, Assembly and Stowage **(MIDAS)**. The **MIDAS** is a facility class payload that will be used to support the HRF.

The primary governing documents for the requirements levied in this document are LS-71000, Program Requirements Document for the Human Research Facility and SSP57000, Pressurized Payloads Interface Requirements Document. Other requirements are derived from the experiment unique interface definition documents for the various items of HRF equipment.

The requirements in Sections 3, 4 and 5 of this document consist of a minimum set of constraints for the **MIDAS** hardware. Hardware Criticality is defined in the table in Section 3.2 of LS-71000.

The HRF Project Office is the controlling authority for this document. The HRF Configuration Control Board (CCB) or a delegated authority must approve any deviations from the requirements of this document.

2.0 APPLICABLE DOCUMENTS

The following applicable documents of the exact issue shown herein form a part of this specification to the extent specified herein. If a revision level or date is not cited, the latest version of the document should be used.

All specifications, standards, exhibits, drawings or other documents referenced in this specification are hereby incorporated as cited in the text of this document. Any updated revisions to documents specified herein shall be reviewed to determine the impact to the design. Changes to the design or this document shall only be made upon the direction of the HRF CCB.

2.1 DOCUMENTS

Document Number	Revision	Document Title
220G07455	Rev. C 4/96	Rack Handling Adapters – Upper Structure
220G07470	Rev. B 3/95	Rack Handling Adapters – MSFC Base Assembly
220G07475	Rev. C 4/96	Rack Handling Adapters – SSPF Base Assembly
220G07500	Rev. A 7/95	Rack Shipping Containers
683–10007	Rev. H 3/88	Fire Detection Assembly
COL–RIBRE–SPE–0164	3/01	Columbus Pressurized Payloads Interface Requirements Document
FED-STD-595	Rev. B 12/89	Colors Used in Government Procurement
JPD 5335.1	Rev. C	Lyndon B. Johnson Space Center Quality Management System (QMS)
JSC 28169	Rev. A 2/00	Interface Control Document for the International Space Station Resupply Stowage Platform 1 Stowage System to Cargo Providers
JSC 32216	9/97	Reliability and Maintainability Plan for Engineering Directorate Developed Hardware for the Space Shuttle Program and the Space Station Freedom Program
KHB 1700.7	Rev. C 8/99	Space Shuttle Payload Ground Safety Handbook

Document Number	Revision	Document Title
LS-71000	Rev. A 04/00	Program Requirements Document for the Human Research Facility
LS-71011	Rev. A 10/01	Acoustic Noise Control & Analysis Plan for Human Research Facility Payloads and Racks
LS-71016	Rev. A 8/01	Electromagnetic Compatibility Control Plan for the Human Research Facility
LS-71053-1	Issue 3 Rev. 2 8/98	Hardware Requirements Document for the Muscle Atrophy Research and Exercise System of the Human Research Facility
MARES-0000-SP-103-NTE	Issue 1 4/00	MARES-HRF Interface Specification
MIL-PRF-19500	Rev. M 10/99	Performance Specification Semiconductor Devices, General Specification for
MIL-STD-810	Rev. F Chg. 2 8/02	Environmental Test Methods and Engineering Guidelines
MIL-STD-1686	Rev. C 10/95	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
NASA TM 102179	6/91	Selection of Wires and Circuit Protective Devices for STS Orbiter Vehicle Payload Electrical Circuits
NHB 6000.1D	2/01	Requirements for Packaging, Handling, and Transportation – Electronics Control Unit (ECU)
NSTS/ISS 13830	Rev. C, Ch. 1 2/99	Payload Safety Review and Data Submittal Requirements for Payloads Using the Space Shuttle and International Space Shuttle
NSTS-1700.7	Rev. B, Ch. 11 5/01	Safety Policy and Requirements For Payloads Using the Space Transportation System
NSTS-1700.7B ISS ADDENDUM	Ch. 4 8/02	Safety Policy and Requirements For Payloads Using the International Space Station
NSTS/ISS 18798	Rev. B, Ch. 7 2/00	Interpretations of NSTS/ISS Payload Safety Requirements

Document Number	Revision	Document Title
NSTS-21000-IDD-MDK	Rev. B Chg 14 9/02	Shuttle/Payload Interface Definition Document for Middeck Accommodations
SN-C-0005	Rev. D Chg 6 7/98	Space Shuttle Contamination Control Requirements
SP-T-0023	Rev. C 05/01	Specification, Environmental Acceptance Testing
SSP 30223	Rev. J 7/00	Problem Reporting and Corrective Action for the Space Station Program
SSP 30233	Rev. F 7/99	Space Station Requirements for Materials and Processes
SSP 30237	Rev. F Chg 20 03/02	Space Station Electromagnetic Emission and Susceptibility Requirements
SSP 30240	Rev. C Chg. 6 3/02	Space Station Grounding Requirements
SSP 30242	Rev. E Chg. 7 10/01	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility
SSP 30243	Rev. F, 4/02	Space Station Requirements for Electromagnetic Compatibility
SSP 30245	Rev. E Chg. 16 10/01	Space Station Electrical Bonding Requirements
SSP 30257:004	Rev. E 11/96	Space Station Program Intravehicular Activity Restraints and Mobility Aids Standard ICD
SSP 30262:013	Rev. G 4/98	Smoke Detector Assembly Standard ICD
SSP 30312	Rev. H Chg. 1 3/02	Electrical, Electronic, and Electromechanical (EEE) and Mechanical Parts Management and Implementation Plan for Space Station Program
SSP 30423	Rev. H 1/00	Space Station Approved EEE Parts List
SSP 30512	Rev. C 9/94	Space Station Ionizing Radiation Design Environment
SSP 30695	Rev. A 01/95	Acceptance Data Package Requirements Specification

Document Number	Revision	Document Title
SSP 41002	Rev. K 7/01	International Standard Payload Rack to NASA/ESA/NASDA Modules Interface Control Document
SSP 41017	Rev. F 01/02	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part 1
SSP 41017	Rev. H 5/01	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part 2
SSP 50005	Rev. C Chg. 8 9/0198	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T)
SSP 50008	Rev. C 7/01	International Space Station Interior Color Scheme
SSP 50251	Baseline 10/00	ARIS to Pressurized Element Interface Control Document, Part 2
SSP 50467	Baseline 11/00	ISS Cargo Stowage Technical Manual: Pressurized Volume
SSP 52005	Rev. B 3/99	Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures
SSP 57000	Rev. E 11/00	Pressurized Payloads Interface Requirements Document
SSP 57001	Rev. C 10/00	Pressurized Payloads Hardware Interface Control Document Template
SSP 57020	Rev. A 6/02	Payload Accommodation Handbook
SSP 57245	Draft 1/02	MARES-MIDAS Hardware Interface Control Document
SSQ 21635	Rev J. 1/00	Connectors and Accessories, Electrical, Rectangular, Rack and Panel

2.2 ORDER OF PRECEDENCE

In the event of a conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3.0 SYSTEM REQUIREMENTS

3.1 ITEM DEFINITION

The following items of MIDAS will be designed and certified under this requirements document for use on International Space Station (ISS) as a part of the HRF program. The MARES hardware used with this hardware is certified under separate documentation that is maintained by the appropriate program(s).

Table 3.1-1 lists the equipment items covered by this document, including the stowage kits that will be used to transport the items and contain the items on-orbit.

TABLE 3.1-1. MIDAS ITEMS

Item Name	Part Number	Class	Qty.	Notes
MIDAS Structure	*SEG4611XXXX-30X*	I	#	
UIP/MIDAS Power Cable	*SEG4611XXXX-30X*	I	#	aux power
HRF Common Power Cable 120VDC	*SEG46115684-30X*	I	#	PIP to MARES, 8' long
UOP/External Power Supply Cable	SEG46116745-30X	I	#	uop to PIP connection, 21' long
MIDAS Stowage Kit(s)	SJG4611XXXX-30X	I	#	stowage concepts are TBD
PIP (Power Interface Panel)	SEG4611XXX-30X	I	#	portable, mounted on seat tracks

3.1.1 System Description

The purpose of MIDAS is to accommodate the stowage of the HRF Muscle Atrophy Research and Exercise System (MARES) and to provide a selectable Utility Outlet Panel (UOP)/Utility Interface Panel (UIP) power interface. The MIDAS will launch in the MPLM on flight UF-3 and be installed in a rack space within the APM. All MIDAS components except the rack structure will be stowed during launch.

The MARES and all its components, provided by the European Space Agency (ESA), will be launched on UF3. During launch and landing, the MARES elements will either be mounted on the MIDAS structure or stowed in launch containers. During on-orbit operations, MARES will be deployed in the aisle. When not used on-orbit MARES will be stowed.

Following transfer of this hardware to the APM, the MARES Main Box will be attached to the Vibration Isolation Frame (VIF). The VIF attaches to the MIDAS structure via seat tracks. Further operations require attachment of the pantograph,

chair and power cable prior to the first session. MARES power is obtained primarily through the rack UIP connector or secondarily via a UOP or Standard Utility Panel (SUP). Stowage will be within the rack space occupied by the MIDAS-MARES system. None of this hardware has a planned return flight.

The interfaces among the MIDAS components, MARES, and ISS are presented in Figure 3.1.1-1.

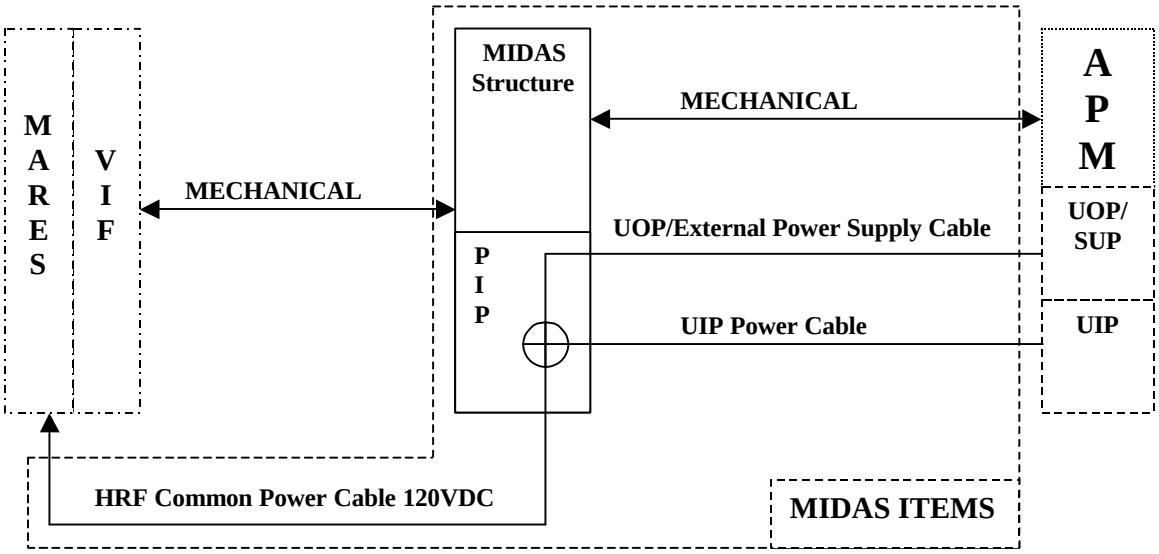


Figure 3.1.1-1. MIDAS Mechanical & Electrical Interfaces

3.1.1.1 Muscle Atrophy Research and Exercise System (MARES)

MARES will be used to carry out research on muscle-skeletal, biomechanical, neuromuscular and neurological physiology, to study the effect of microgravity on the human being, and to evaluate the effect of the countermeasures to the Space environment induced physiological effects. It can also be used to evaluate the performance of exercise tests protocols. The requirements for the MARES and its components are specified in LS-71053-1, HRD for the MARES of the HRF.

3.1.1.2 Vibration Isolation Frame (VIF)

The purpose of the Vibration Isolation Frame is to avoid the perturbation of the microgravity environment of ISS while MARES is in use. At the same time, it keeps MARES in its correct position, and limits the range of displacement of the equipment. Requirements for the VIF are the responsibility of the MARES project team and are specified in the MARES HRD, LS-71053-1.

3.1.2 MIDAS Component description

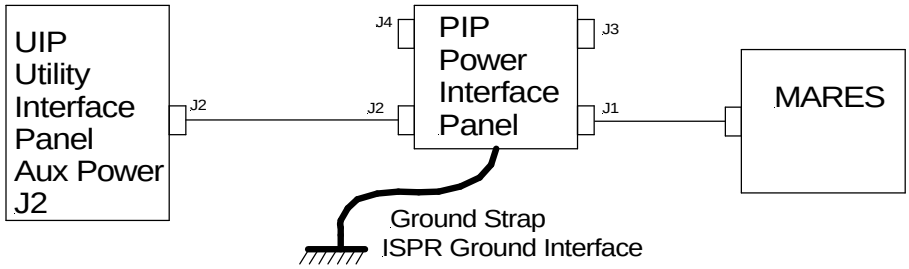
3.1.2.1 MIDAS Structure

The MIDAS structure is attached to the Columbus Attached Pressurized Module (APM) provided by ESA. The structure design will be based on an International Standard Payload Rack (ISPR). The MIDAS structure will allow for deployment and stowage of the MARES system within an empty rack space. The MIDAS attaches to the MARES mechanically via the VIF.

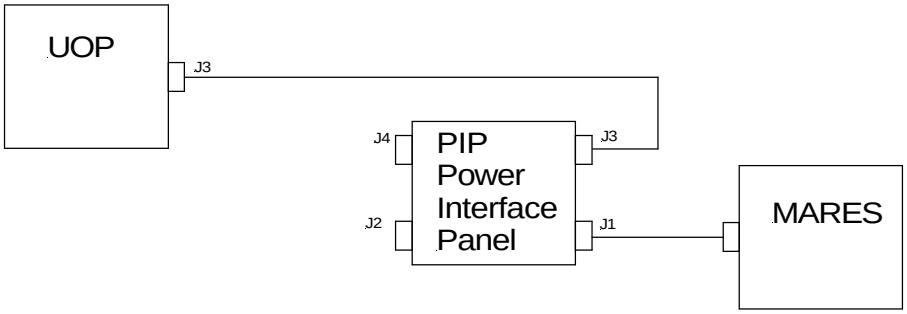
The MIDAS structure will also accommodate all MARES hardware manifested for UF-3 during launch.

3.1.2.2 Power Interface Panel (PIP)

The Power Interface Panel (PIP) is a portable box intended to interface the MARES to both the UIP and the UOP. The box may be relocated in support of the MARES. The maximum capacity of the PIP will be 120VDC at 12A. Other payloads requiring inputs at or below this level can also utilize the PIP. The interface concept for the UIP/UOP, PIP, and MARES is shown in Figure 3.1.2.2-1.



MARES UIP CONNECTION



MARES UOP CONNECTION

Figure 3.1.2.2-1. Power Interface Panel Connections

3.1.2.3 UIP/MIDAS Power Cable

The UIP/MIDAS Power Cable is the electrical power cable that connects the APM's electrical power source on the UIP to the Payload Interface Panel (PIP). The nominal power source for the MARES when attached to the PIP will be the UIP.

3.1.2.4 UOP/External Power Supply Cable

The UOP/External Power Supply Cable connects the APM's electrical power source on either the SUP or UOP to the MIDAS PIP. The SUP/UOP will be used as an alternative power source.

3.1.2.5 HRF Common Power Cable 120VDC

The HRF Common Power Cable 120VDC connects the PIP to the MARES Main Box.

3.1.3 Interface Definition

3.1.3.1 Vibration Isolation Frame (VIF) to MIDAS Interface

The Vibration Isolation Frame to MIDAS Interface is the mating plane of the connection that attaches the VIF to MIDAS. The VIF will attach to the MIDAS structure via seat tracks.

3.1.3.2 UIP Power Interface

Electrical power is supplied through the UIP connector on the Z panel of the APM rack space. The UIP/MIDAS Power Cable is the interface that attaches the UIP to the PIP. The HRF Common Power Cable 120VDC is used to connect the MARES to the PIP and provide the MARES Main Box its 120 Vdc electrical power.

3.1.3.3 SUP/UOP Power Interface

Electrical power is supplied through the either the UOP or SUP connectors in the APM. The UOP/External Power Supply Cable is the interface between the UOP/SUP and the PIP. The HRF Common Power Cable 120VDC is used to connect the MARES to the PIP and provide the MARES Main Box its 120VDC electrical power.

3.1.3.4 MIDAS to APM structural interface

The MIDAS structure attaches to the APM at existing rack attachment points.

3.1.3.5 MIDAS to MPLM structural interface

The MIDAS structure attaches to the MPLM at existing rack attachment points. The MIDAS structure will support MARES hardware during UF-3 launch.

3.1.4 Operations

3.1.4.1 Launch/Landing Operation

The MIDAS structure will be launched in the MPLM on UF3. The MIDAS structure will be installed into the APM on-orbit. All components will be stowed during launch and are neither powered nor operated.

All MARES hardware that is utilized for on-orbit checkout will be flown during UF-3. The MIDAS will accommodate this hardware in some fashion during launch in the MPLM, whether mounted to the MIDAS structure or stored in containers on an RSP1SS

3.1.4.2 On-Orbit Operation

The MIDAS and MARES hardware will be transferred to the APM following launch. The VIF will be attached to the MIDAS for on-orbit stowage and use via standard seat tracks. The MARES Main Box, Pantograph, and Chair are attached to the VIF for on-orbit use, and detached for stowage. Hardware accessories will be placed in the free space around the Main Box, Pantograph, Chair and VIF for on-orbit stowage. All MARES accessories will be deployed only when needed for operations.

3.2 CHARACTERISTICS

3.2.1 Performance Characteristics

3.2.1.1 Functional Performance Characteristics

a. MIDAS shall attach to existing ISS hardware without modification.

b. MIDAS shall have minimal activities required to attach the MARES Main Box and VIF.

c. MIDAS shall be able to minimize the MARES stowed envelope while allowing deployment in a manner conducive to operations.

d. MIDAS shall provide stowage capability for all MARES hardware.

e. MIDAS shall accommodate all MARES hardware manifested for UF3 within a RSP1SS launch envelope.

f. MIDAS shall provide a power interface to attach the MARES to either the UIP or the SUP/UOP.

g. MIDAS shall provide a logistical launch plan for all MARES hardware not launched on UF3.

3.2.2 Physical Characteristics

3.2.2.1 Mass and Center of Gravity Properties

Integrated racks shall be limited to 804.2 kg (1773 lbs) for launch and landing in the MPLM and for ground and on-orbit operations. [SSP57000E, paragraph 3.1.1.4A]

Center of gravity data for the MIDAS shall be provided for integration purposes.

3.2.2.2 Envelope

3.2.2.2.1 Stowed Envelope

Stowage interface information is provided in SSP 50467, ISS Stowage Accommodations Handbook: Pressurized Volume.

3.2.2.2.2 Deployed Envelope

3.2.2.2.2.1 On-Orbit Payload Protrusions

Definitions for on-orbit permanent protrusions, on-orbit semi-permanent protrusions, on-orbit temporary protrusions, on-orbit momentary protrusions, and protrusions for on-orbit keep alive payloads can be found in Section 6.1, Definitions. The requirements in Section 3.2.2.2.2.1 apply to installation and operation activities, but not to maintenance activities.

NOTE: The on-orbit protrusion requirements in this section are applicable to when the payload is on-orbit and do not apply to other phases of the transportation of the payload (e.g., launch, landing, Mini Pressurized Logistics Module (MPLM) installation). (SSP 57000E, Section 3.1.1.7)

A. On-orbit protrusions, excluding momentary protrusions, shall not extend laterally across the edges of the rack or pass between racks. (SSP 57000E, Section 3.1.1.7.A)

B. The integrated MIDAS/MARES hardware, excluding momentary protrusions, shall not prevent attachment of Rack Mounting Adapter (RMA) on any seat track attach holes. (SSP 57000E, Section 3.1.1.7.B)

Constraints which may be associated with payload protrusions include:

- removal of the protrusion during rack installation, translation, and crew translation
- removal of the protrusion if RMA is installed on the rack
- removal of the protrusion to prevent interference with microgravity operations

- removal or powering off of the rack if the protrusion blocks Portable Fire Extinguisher (PFE) access or the fire indicator

- may limit the rack location (e.g., Protrusion located in the floor and the ceiling are limited to a total of no more than 12 inches.)

- may limit operation of the payload

As is indicated by the constraints above, protrusions have a negative impact on crew operations and are to be minimized. (**SSP 57000E, paragraph 3.1.1.7**)

3.2.2.2.2.1.1 On-Orbit Permanent Protrusions

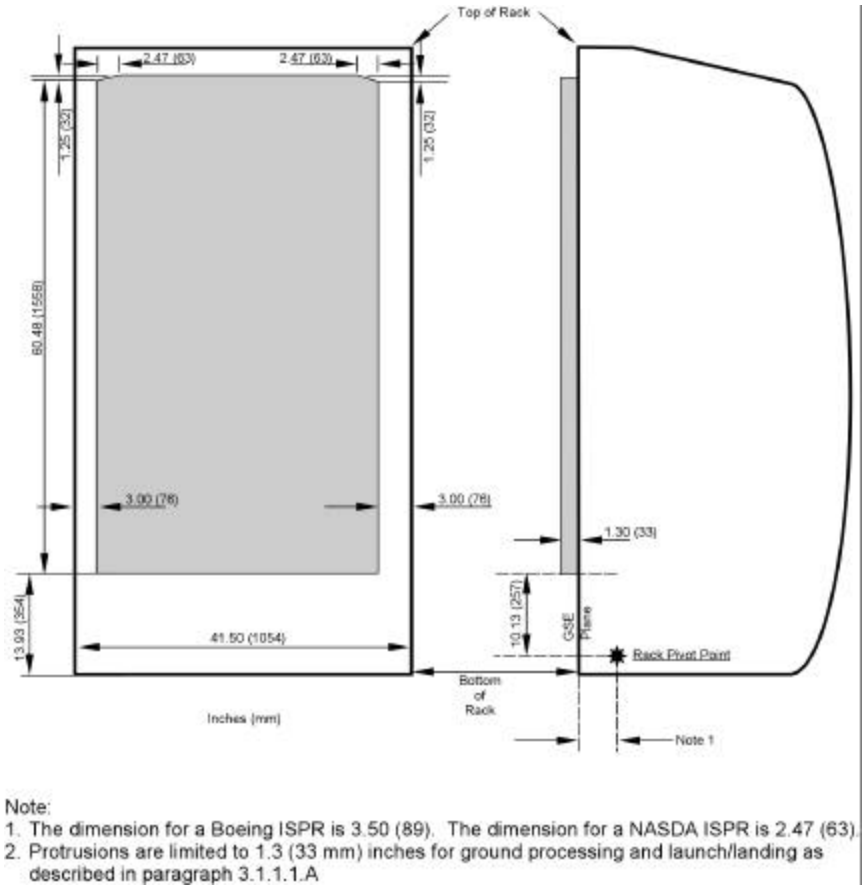
Not applicable to MIDAS.

3.2.2.2.2.1.2 On-Orbit Semi-Permanent Protrusions

A. Not applicable to MIDAS.

B. Other on-orbit semi-permanent protrusions shall be limited to no more than 500 square inches within the envelope shown in Figure 3.2.2.2.2.1.2-1. **[SSP 57000E, paragraph 3.1.1.7.2.B]**

C. All on-orbit semi-permanent protrusions shall be designed to be removable by the crew with hand operations and/or standard Intravehicular Activity (IVA) tools. **[SSP 57000E, paragraph 3.1.1.7.2.C]**



Note:
1. The dimension for a Boeing ISPR is 3.50 (89). The dimension for a NASDA ISPR is 2.47 (63).
2. Protrusions are limited to 1.3 (33 mm) inches for ground processing and launch/landing as described in paragraph 3.1.1.1.A

Figure 3.2.2.2.2.1.2-1. On-Orbit Semi-Permanent Protrusions Envelope

3.2.2.2.2.1.3 On-Orbit Temporary Protrusions

A. On-orbit temporary protrusions shall remain within the envelope shown in Figure 3.2.2.2.2.1.3-1. **[SSP 57000E, paragraph 3.1.1.7.3.A]**

B. The combination of all on-orbit temporary protrusions for the integrated MIDAS/MARES shall be designed such that they can be eliminated or returned to their stowed configuration by the crew with hand operations and/or standard IVA tools within 10 minutes. **[SSP 57000E, paragraph 3.1.1.7.3.B]**

NOTE: MIDAS must provide stowage for on-orbit temporary protrusions within its stowage allocation. **[SSP 57000E, paragraph 3.1.1.7.3]**

NOTE: On-orbit temporary protrusions for payloads located in the floor or ceiling are limited to 6 inches each or a total of 12 inches for both floor and ceiling. **[SSP 57000E, paragraph 3.1.1.7.3]**

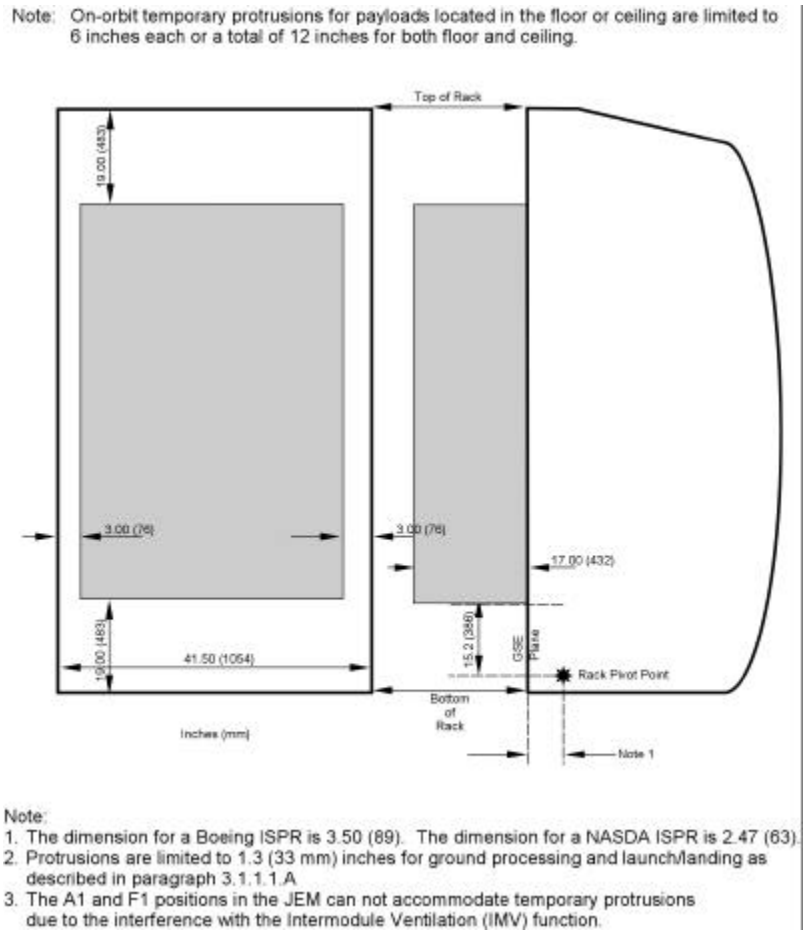


Figure 3.2.2.2.2.1.3-1. On-Orbit Temporary Protrusions Envelope

3.2.2.2.2.1.4 On-Orbit Momentary Protrusions

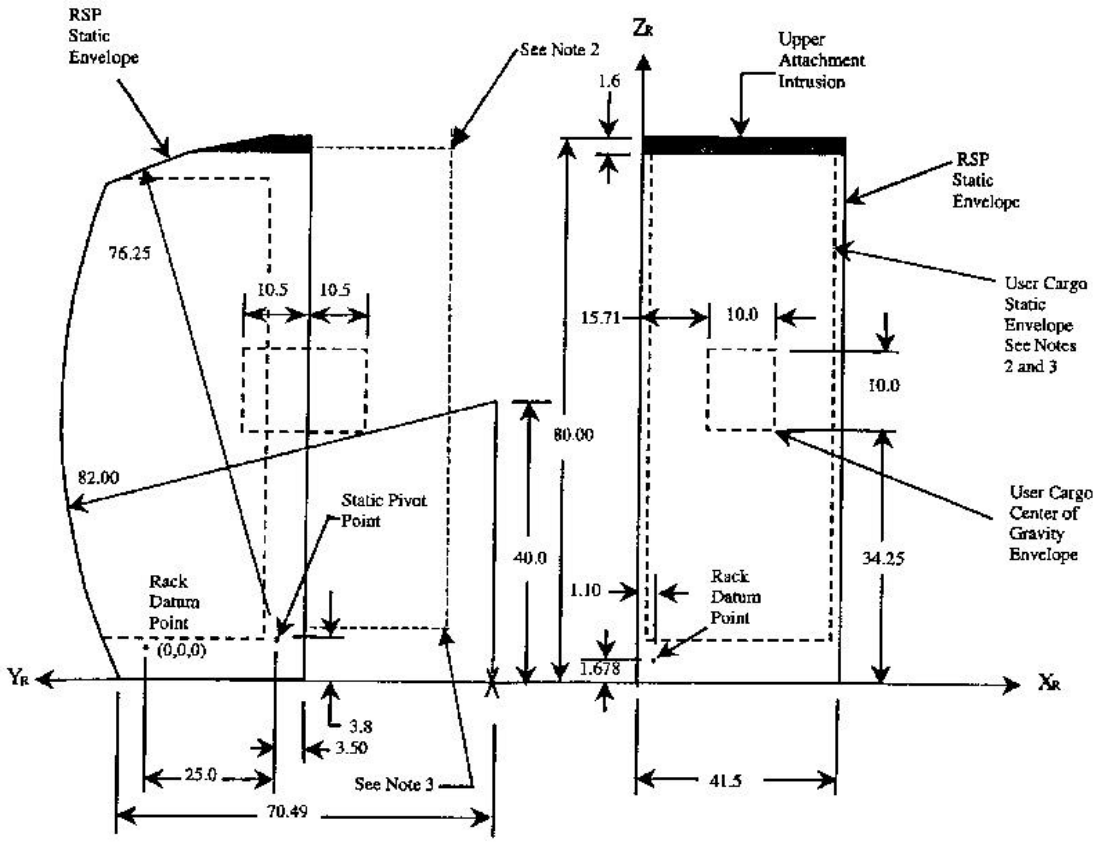
Not applicable to MIDAS.

3.2.2.2.2.2 Deployed Envelope Dimensions

The MIDAS deployed enveloped dimensions are dependent on the MARES hardware. Deployed envelope dimensions will be measured and verified at an integrated hardware level and is outside the scope of this document.

3.2.2.2.3 Launch Envelope

The MIDAS hardware will support all MARES hardware required for on-orbit checkout during the UF-3 launch. The envelope of this hardware attached to the MIDAS will not exceed the combined launch envelope of an ISPR and an RSP1SS, as shown in Figures 3.2.2.2.3-1 and 3.2.2.2.3-2.

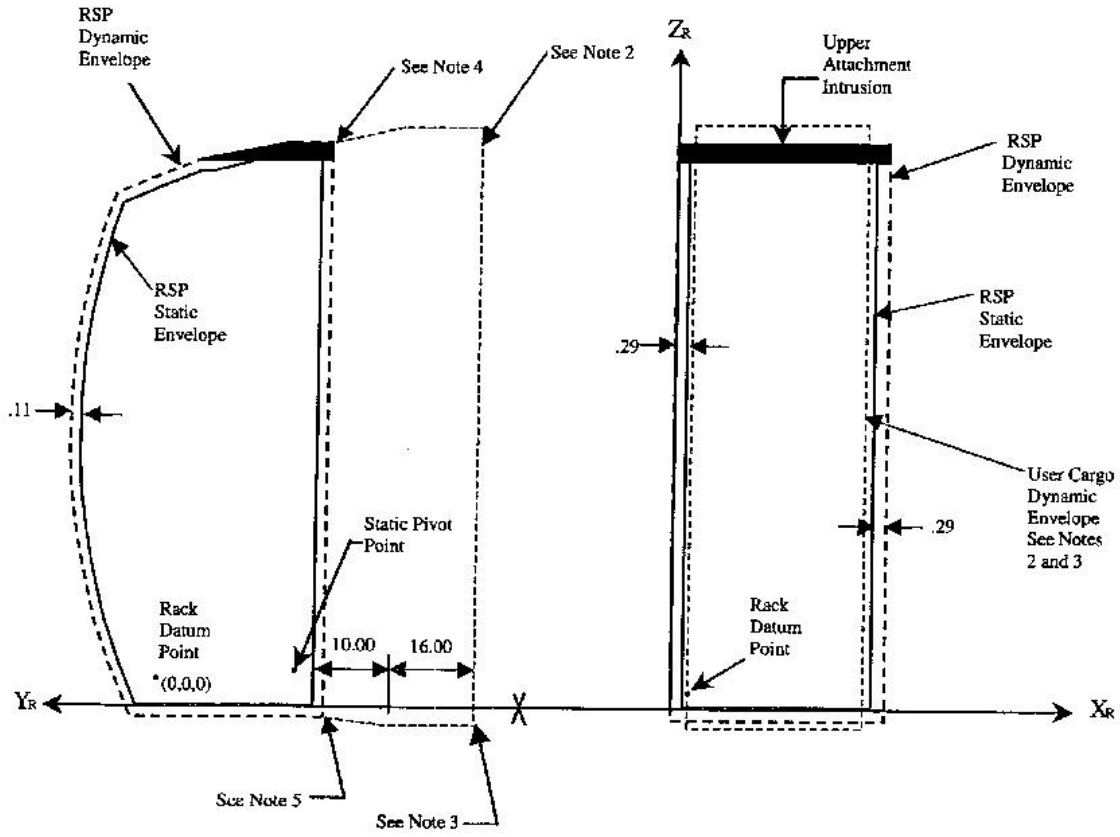


NOTE: 1. No single item shall have a CG of more than 10.5 inches off the front or rear face plate.

2. Upper Envelope boundary coordinates: X = 1.484 (37.69), Y = -51.92 (-1318.77), Z = 77.225 (1961.52); X = 37.816 (960.52), Y = -51.92 (-1318.77), Z = 77.225 (1961.52)

3. Lower Envelope boundary coordinates: X = 1.484 (37.69), Y = -51.92 (-1318.77), Z = 1.965 (49.91); X = 37.816 (960.52), Y = -51.92 (-1318.77), Z = 1.965 (49.91)

Figure 3.2.2.2.3-1. RSP1SS Static Envelope



NOTE: 1. No single item shall have a CG of more than 10.5 inches off the front or rear face plate.

2. Upper Envelope boundary coordinates: X = -0.89 (-22.60), Y = -53.92 (-1369.57), Z = 79.580 (2021.33); X = 40.19 (1020.82), Y = -53.92 (-1369.57), Z = 79.580 (2021.33)

3. Lower Envelope boundary coordinates: X = -0.89 (-22.60), Y = -53.92 (-1369.57), Z = -2.936 (-74.57); X = 40.19 (1020.82), Y = -53.92 (-1369.57), Z = -2.936 (-74.57)

4. Upper Envelope boundary coordinates: X = -0.89 (-22.60), Y = 28.608 (726.64), Z =78.322 (1989.37); X = 40.19 (1020.82), Y = 28.608 (726.64), Z =78.322 (1989.37)

5. Lower Envelope boundary coordinates: X = -0.89 (-22.60), Y = 28.608 (726.64), Z = -1.788 (45.41); X = 40.19 (1020.82), Y = 28.608 (726.64), Z = -1.788 (45.41)

Figure 3.2.2.2.3-2. RSP1SS Dynamic Envelope

3.2.3 Reliability, Quality and Non-Conformance Reporting

A. Reliability and maintainability requirements for the MIDAS shall be as defined in JSC 32216, "Reliability and Maintainability Plan for Engineering Directorate Developed Hardware for the Space Shuttle Program and the Space Station Freedom Program".

B. Quality Assurance for the HRF Program shall be implemented in accordance with JPD 5335.1, "JSC Quality Manual".

C. Non-Conformance Reporting

1. For flight hardware produced under a contract or subcontract at a site other than JSC, non-conformance reporting requirements shall be specified in the Statement of Work (SOW) Data Requirements List, and Data Requirements Documents (DRDs) shall be used to identify the submittal and data requirements. (LS-71000A, Section 7.3.2.1)

2. For flight hardware developed at JSC, non-conformance reporting shall be in accordance with JPD 5335.1 and the applicable technical division plan. (LS-71000A, Section 7.3.2.2)

3. Non-conformances, which meet the Level 1 Problem Reporting and Corrective Action criteria for payloads as defined in SSP 30223, shall be reported in accordance with SSP 30223. (LS-71000A, Section 7.3.2.3)

4. Not applicable to MIDAS.

3.2.3.1 Failure Propagation

The design shall preclude propagation of failures from the payload to the environment outside the payload. (NSTS 1700.7B, Section 206)

3.2.3.2 Useful Life

MIDAS hardware shall be designed for a 10-year utilization. (LS-71000A, Section 7.2.1)

3.2.3.2.1 Operational Life (Cycles)

Operational life applies to any hardware that deteriorates with the accumulation of operating time and/or cycles and thus requires periodic replacement or refurbishment to maintain acceptable operating characteristics. Operational life includes the usage during flight, ground testing and pre-launch operations. All components of the MIDAS shall have an operational life limit of 10 years, except those identified as having limited life, see Section 3.2.3.2.3.

3.2.3.2.2 Shelf Life

Shelf life is defined as that period of time during which the components of a system can be stored under controlled conditions and put into service without replacement of parts (beyond servicing and installation of consumables). The MIDAS shall have a shelf life limit of **TBD**.

3.2.3.2.3 Limited Life

Limited life is defined as the life of a component, subassembly, or assembly that expires prior to the stated useful life in Section 3.2.3.2.1. Limited life items or materials, such as soft goods, shall be identified and the number of operation cycles shall be determined. Limited life items shall be tracked on a limited life list that is maintained as a part of the hardware acceptance data pack.

3.2.4 Maintainability

A. Not applicable to MIDAS.

B. All Orbital Replacement Unit (ORU) connectors, whether operated by hand or tool, shall be designed and placed so they can be mated/demated using either hand. (LS-71000A, Section 6.4.4.3.1)

C. It shall be possible to mate/demate individual connectors without having to remove or mate/demate connectors on other ORUs or payloads during maintenance operations. (LS-71000A, Section 6.4.4.3.2B)

D. Electrical connectors and cable installations shall permit disconnection and reconnection without damage to wiring connectors. (LS-71000A, Section 6.4.4.3.2C)

E. Access to inspect or replace a hardware item (e.g., an ORU) which is planned to be accessed on a daily or weekly basis shall not require removal of another hardware item or more than one access cover. (LS-71000A, Section 6.4.4.2.6)

F. Not applicable to MIDAS.

G. Not applicable to MIDAS.

3.2.4.1 Logistics and Maintenance

3.2.4.1.1 Payload In-Flight Maintenance

Payloads shall be designed to be maintainable using Space Station provided onboard tools. A list of available tools on-orbit is defined in the Payload Accommodations Handbook. **[SSP 57000E, paragraph 3.12.10]**

3.2.4.1.2 Maintenance

There are no scheduled or unscheduled maintenance requirements for MIDAS.

3.2.5 Environmental Conditions

3.2.5.1 On-Orbit Environmental Conditions

3.2.5.1.1 On-Orbit Internal Environments

3.2.5.1.1.1 Pressure

The MIDAS shall be safe when exposed to pressures of 0 to 104.8 kPa (0 to 15.2 psia). **[SSP 57000E, paragraph 3.9.1.1]**

3.2.5.1.1.2 Temperature

The MIDAS shall be safe when exposed to temperatures of 10 to 46 °C (50 to 115 °F). **[SSP 57000E, paragraph 3.9.1.2]**

3.2.5.1.1.3 Humidity

Not applicable to the MIDAS.

3.2.5.1.2 Integrated Rack Use of Cabin Atmosphere

3.2.5.1.2.1 Active Air Exchange

Not applicable to MIDAS.

3.2.5.1.2.2 Oxygen Consumption

Not applicable to MIDAS.

3.2.5.1.2.3 Chemical Releases

Chemical releases to the cabin air shall be in accordance with paragraphs 209.1a and 209.1b in NSTS 1700.7B, ISS Addendum. [SSP 57000E, paragraph 3. 9.2.3]

3.2.5.1.2.4 Cabin Air Heat Leak

The sensible heat leak to the cabin air from the MIDAS either alone or together with the other ISPRs simultaneously active will not exceed the limits specified in paragraph 3.5.1.8 of the Pressurized Payload Hardware Interface Control Document, SSP 57001. These limits represent the total cabin air heat load capability when the cabin temperature is at 18° C (65° F). The numbers in this Table are the total cabin heat load allocation for all the ISPR's on a module basis. [SSP 57000E, paragraph 3.5.1.12]

3.2.5.1.3 Ionizing Radiation Requirements

3.2.5.1.3.1 MIDAS Contained or Generated Ionizing Radiation

Integrated racks containing or using radioactive materials or that generate ionizing radiation shall comply with NSTS 1700.7, ISS Addendum, paragraph 212.1. **[SSP 57000E, paragraph 3.9.3.1]**

3.2.5.1.3.2 Ionizing Radiation Dose

MIDAS should expect a total dose (including trapped protons and electrons) of 30 Rads(Si) per year of ionizing radiation. A review of the dose estimates in the ISS (SAIC–TN–9550) may show ionizing radiation exposure to be different than 30 Rads(Si) per year, if the intended location of the rack in the ISS is known. **[SSP 57000E, paragraph 3.9.3.2]**

3.2.5.1.3.3 Single Event Effect (SEE) Ionizing Radiation

Equipment and subsystems shall be designed not to produce an unsafe condition or one that could cause damage to equipment external to the MIDAS as a result of exposure to SEE ionizing radiation assuming exposure levels specified in SSP 30512, paragraph 3.2.1, with a shielding thickness of 25.4 mm (1000 mils). **[SSP 57000E, paragraph 3.9.3.3]**

3.2.5.1.4 Additional Environmental Conditions

The environmental information provided in Table 3.2.5.1.4–1, Environmental Conditions on ISS, is for design and analysis purposes. **[SSP 57000E, paragraph 3.9.3.4]**

TABLE 3.2.5.1.4-1. ENVIRONMENTAL CONDITIONS ON ISS

Environmental Conditions	Value	
Atmospheric Conditions on ISS		
Pressure Extremes	0 to 104.8 kPa (0 to 15.2 psia)	
Normal operating pressure	See Figure 3.2.5.1.4-1	
Oxygen partial pressure	See Figure 3.2.5.1.4-1	
Nitrogen partial pressure	See Figure 3.2.5.1.4-1	
Dewpoint	4.4 to 15.6 °C (40 to 60 °F) ref. Figure 3.2.5.1.1.3-1	
Percent relative humidity	25 to 75 % ref. Figure 3.2.5.1.1.3-1	
Carbon dioxide partial pressure during normal operations with 6 crewmembers plus animals	24-hr average exposure 5.3 mm Hg Peak exposure 7.6 mm Hg	
Carbon dioxide partial pressure during crew changeout with 11 crewmembers plus animals	24-hr average exposure 7.6 mm Hg Peak exposure 10 mm Hg	
Cabin air temperature in USL, JEM, APM and CAM	17 to 28 °C (63 to 82 °F)	
Cabin air temperature in Node 1	17 to 31 °C (63 to 87 °F)	
Air velocity (nominal)	0.051 to 0.203 m/s (10 to 40 ft/min)	
Airborne microbes	Less than 1000 CFU/m3	
Atmosphere particulate level	Average less than 100,000 particles/ft3 for particles less than 0.5 microns in size	
MPLM Air Temperatures	**Passive Flights**	**Active Flights**
Pre-Launch	15 to 24 °C (59 to 75.2 °F)	14 to 30 °C (57.2 to 86 °F)
Launch/Ascent	14 to 24 °C (57.2 to 75.2 °F)	20 to 30 °C (68 to 86 °F)
On-Orbit (Cargo Bay + Deployment)	24 to 44 °C (75.2 to 111.2 °F)	16 to 46 °C (60.8 to 114.8 °F)
On-Orbit (On-Station)	23 to 45 °C (73.4 to 113 °F)	16 to 43 °C (60.8 to 109.4 °F)
On-Orbit (Retrieval + Cargo Bay)	17 to 44 °C (62.6 to 111.2 °F)	11 to 45 °C (51.8 to 113 °F)
Descent/Landing	13 to 43 °C (55.4 to 109.4 °F)	10 to 42 °C (50 to 107.6 °F)
Post-Landing	13 to 43 °C (55.4 to 109.4 °F)	10 to 42 °C (50 to 107.6 °F)
Ferry Flight	15.5 to 30 °C (59.9 to 86 °F)	15.5 to 30 °C (59.9 to 86 °F)
MPLM Maximum Dewpoint Temperatures		
Pre-Launch	13.8 °C (56.8 °F)	12.5 °C (54.5 °F)
Launch/Ascent	13.8 °C (56.8 °F)	12.5 °C (54.5 °F)
On-Orbit (Cargo Bay +Deployment)	13.8 °C (56.8 °F)	12.5 °C (54.5 °F)
On-Orbit (On Station)	15.5 °C (60 °F)	15.5 °C (60 °F)
On-Orbit (Retrieval +Cargo Bay)	10 °C (50 °F)	10 °C (50 °F)
Descent/Landing	10 °C (50 °F)	10 °C (50 °F)
Post Landing	10 °C (50 °F)	10 °C (50 °F)
Ferry Flight	15.5 °C (60 °F)	15.5 °C (60 °F)
Thermal Conditions		
USL module wall temperature	13 °C to 43 °C (55 °F to 109 °F)	
JEM module wall temperature	13 °C to 45 °C (55 °F to 113 °F) **(TBR)**	
APM module wall temperature	13 °C to 43 °C (55 °F to 109 °F) **(TBR)**	
CAM module wall temperature	13 °C to 43 °C (55 °F to 109 °F) **(TBR)**	
Other integrated payload racks	Front surface less than 37 °C (98.6 °F)	
***Microgravity**		
Quasi-Steady State Environment	See SSP 57000E Figures 3.9.4-2, 3.9.4-3 and Table 3.9.4-2	
Vibro-accoustic Environment	See SSP 57000E Figure 3.9.4-4	
General Illumination	108 Lux (10 fc) measured 30 inches from the floor in the center of the aisle	

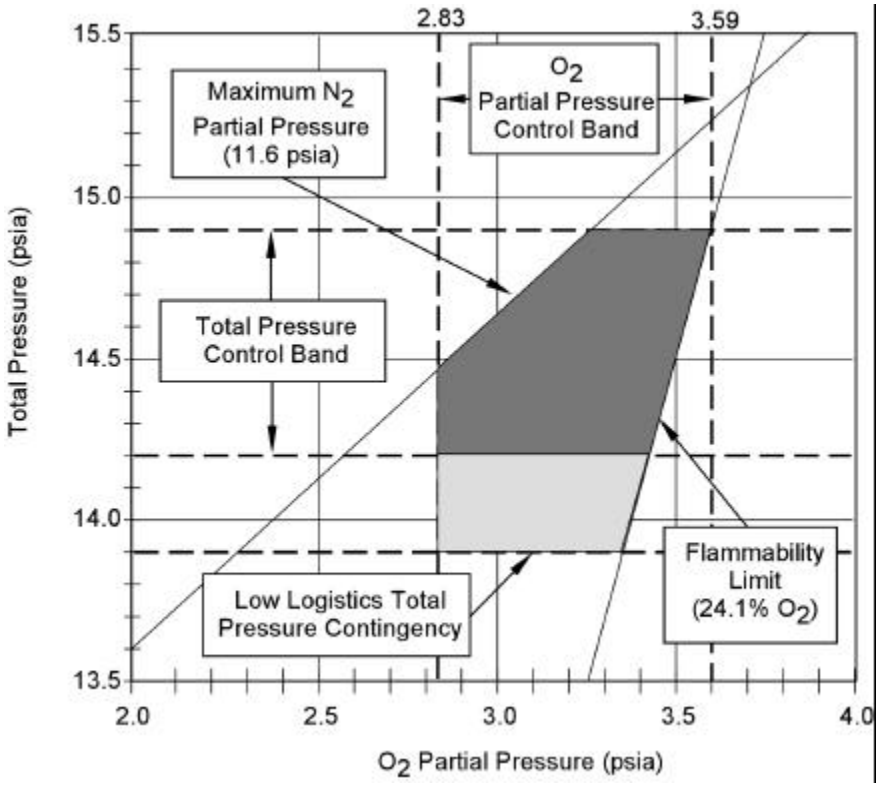


Figure 3.2.5.1.4-1. Operating Limits of the ISS Atmospheric Total Pressure, Nitrogen and Oxygen Partial Pressures

3.2.5.1.5 Pressure Rate of Change

A. MIDAS shall maintain positive margins of safety for the on-orbit depress/repress rates identified in SSP 41002 paragraph 3.1.7.2.1. **[SSP 57000E, paragraph 3.1.1.4.B]**

B. MIDAS shall maintain positive margins of safety for MPLM depress rates of 890 Pa/second (7.75 psi/minute) and repress rates of 800 Pa/second (6.96 psi/minute). **[SSP 57000E, paragraph 3.1.1.2.B]**

C. Not applicable to MIDAS.

D. Not applicable to MIDAS.

3.2.5.2 Acoustic Emission Limits

Not applicable to MIDAS.

3.2.5.3 Lighting Design

The general illumination of the space station in the aisle will be a minimum of 108 lux (10 foot candles) of white light. This illumination will be sufficient for ordinary payload operations performed in the aisle (e.g., examining dials or panels, reading procedures, transcription, tabulation, etc.).

Payloads will meet the following requirements:

A. Payload work surface specularity shall not exceed 20 percent. Paints listed in Table 3.2.5.3-1 meet this requirement. (LS-71000A, Section 6.4.3.4A)

B. Not applicable to MIDAS.

C. Not applicable to MIDAS.

D. Not applicable to MIDAS.

E. Medium payload operational tasks shall utilize the ISS Portable Utility Light (PUL) specified in JSC 27199. (LS-71000A, Section 6.4.3.4E)

TABLE 3.2.5.3-1. SURFACE INTERIOR COLORS AND PAINTS

Hardware Description	Color	Finish	Paint Specification Per FED-STD-595
Equipment Rack Utility Panel Recess	White	Semigloss	27925
Equipment Rack Utility Panel Text Characters	Black	Lusterless	37038
ISPR Utility Panel Recess	White	Semigloss	27925
ISPR Utility Panel Recess Text Characters	Black	Lusterless	37038
Functional Unit Utility Panel Recess (as applicable)	White	Semigloss	27925
Functional Unit Utility Panel Recess Text Characters	Black	Lusterless	37038
Rack Front Aisle Extensions	Off-White	Semigloss	27722
Overhead Rack Face Plates	Off-White	Semigloss	27722
Port Rack Face Plates	Off-White	Semigloss	27722
Starboard Rack Face Plates	Off-White	Semigloss	27722
Deck Rack Face Plates	Off-White	Semigloss	27722
Overhead Rack Utility Panel Closeouts	Off-White	Semigloss	27722
Port Rack Utility Panel Closeouts	Off-White	Semigloss	27722
Starboard Rack Utility Panel Closeouts	Off-White	Semigloss	27722
Deck Rack Utility Panel Closeouts	Off-White	Semigloss	27722
Stowage Trays	Off-White	Semigloss	27722
Stowage Tray Handle Straps (any location)	Blue material	Semigloss	25102 or equiv.
Common Seat Track Interface	Clear (Anodized)	Semigloss	none
Glovebox (Aluminum or Plastic)	Medium Gray	Gloss	16329 or 16373
Glovebox (Aluminum)	White	Gloss	17925
Glovebox (Aluminum or Plastic)	Off-White	Gloss	17722
Glovebox (Aluminum)	Tan	Gloss	10475
EXPRESS Program Rack Utility Panels	Off-White	Gloss	17875

TABLE 3.2.5.3-2. PAYLOAD REQUIRED ILLUMINATION LEVELS

Type of Task	Required Lux (Foot-Candles)*
Medium payload operations (not performed in the aisle) (e.g., payload change-out and maintenance)	325 (30)
Fine payload operations (e.g., instrument repair)	1075 (100)
Medium glovebox operations (e.g., general operations, experiment set-up)	975 (90)
Fine glovebox operations (e.g., detailed operations, protein crystal growth, surgery/dissection, spot illumination)	1450 (135)

*As measured at the task site

3.2.6 Transportability

3.2.6.1 Launch and Landing

Not applicable to MIDAS.

3.2.7 Operational Interface Requirements

3.2.7.1 Mechanical Interface Requirements

3.2.7.1.1 GSE Interfaces

A. MIDAS shall interface to the Kennedy Space Center (KSC) GSE Rack Insertion Device in accordance with SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope, 3.2.1.4.3 Interface Loads, and SSP 41017 Part 2, paragraph 3.3.2 Upper Attachment Interfaces and 3.3.3 Ground Handling Attachment Interfaces. **[SSP 57000E, paragraph 3.1.1.1.A]**

B. MIDAS shall interface to Rack Shipping Containers in accordance with the Teledyne Brown Engineering (TBE) as-built drawing 220G07500. **[SSP 57000E, paragraph 3.1.1.1.B]**

C. MIDAS shall interface to Rack Handling Adapters (RHA) in accordance with the following TBE as-built drawings: 220G07455 Upper Structure Assembly, 220G07470 MSFC Base Assembly, and 220G07475 SSPF Base Assembly. **[SSP 57000E, paragraph 3.1.1.1.C]**

D. MIDAS shall be limited to ground transportation accelerations of 80% of flight accelerations defined by SSP 41017 Part 1, paragraph 3.2.1.4.2. **[SSP 57000E, paragraph 3.1.1.1.D]**

3.2.7.1.2 Module Interfaces

3.2.7.1.2.1 MPLM Interfaces

A. MIDAS racks shall interface to the MPLM structural attach points in accordance with SSP 41017 Part 2, paragraph 3.1.1. **[SSP 57000E, paragraph 3.1.1.2.A]**

B. MIDAS shall be limited to producing interface attach point loads less than or equal to those identified by SSP 41017 Part 1, paragraph 3.2.1.4.3, based upon an acceleration environment as defined in SSP 41017 Part 1, paragraph 3.2.1.4.2. **[SSP 57000E, paragraph 3.1.1.2.E]**

3.2.7.1.3 MIDAS Rack Structure Requirements

A. MIDAS shall comply with the keepout zone for rack pivot mechanism as defined in SSP 41017 Part 1, paragraph 3.2.1.1.2. **[SSP 57000E, paragraph 3.1.1.4.E]**

B. MIDAS with and/or without MARES installed shall be capable of rotating a minimum of 80 degrees about the pivot point for on-orbit installation, removal, and maintenance functions. **[SSP 57000E, paragraph 3.1.1.4.I]**

C. HRF racks requiring rotation shall use the rack and crew restraints identified in SSP 30257:004 (for example, the 14 inch fixed length tether and the 71 inch adjustable length tether) to secure the rack in these rotated positions for payload operations and maintenance. **[SSP 57000E, paragraph 3.1.1.4.L]**

3.2.7.1.4 Connector and Umbilical Physical Mate

3.2.7.1.4.1 Connector Physical Mate

HRF racks shall physically mate with the Utility Interface Panel (UIP) and Fluid Services connectors intended to be used by the payload as listed in Table 3.2.7.1.4.1–1. **[SSP 57000E, paragraph 3.1.1.6.1]**

TABLE 3.2.7.1.4.1–1. MODULE CONNECTORS

	Module Connector	Module Part Number	Resource
UIP			
A	J1	NATC07T25LN3SN	Main Power
B	J2	NATC07T25LN3SA	Essential/Auxiliary Power
C	J3	NATC07T15N35SN	1553 Bus A
D	J4	NATC07T15N35SA	1553 Bus B
E	J7	NATC07T13N4SN	HRDL
F	J16	NATC07T15N97SB	Optical Video
G	J43	NATC07T13N35SA	FDS/Power Maintenance
H	J45	NATC07T11N35SC	EWACS
I	J46	NATC07T11N35SA	LAN-1
J	J47	NATC07T11N35SB	LAN-2
K	J77	NATC07T13N35SB	Electrical Video
L	TCS Mod	683-16348, male, Category 6, Keying B	TCS Mod Supply
M	TCS Mod	683-16348, male, Category 6, Keying C	TCS Mod Return
N	TCS Low	683-16348, male, Category 6, Keying B	TCS Low Supply
O	TCS Low	683-16348, male, Category 6, Keying C	TCS Low Return
P	GN2	683-16348-352	GN2
Q	Vacuum Exhaust	683-16348, male, Category 3, Keying B	Vacuum Exhaust
R	Vacuum Resource	683-16348, male, Category 3, Keying A	Vacuum Resource
S	Ar	683-16348, male, Category 8, Keying C	AR
T	He	683-16348, male, Category 8, Keying E	HE
U	CO2	683-16348, male, Category 8, Keying D	CO2
FLUID SERVICES			
V	Potable Water	683-16348, male, Category 7, Keying D	Potable Water
W	Fluid System Servicer	per Dwg 683-16348, male, 0.50 QD, Universal (no-keying)	Fluid System Servicer
UOP			
X	J3	NATC00T15N97SN	Power/1553 Bus
Y	J4	NATC00T15N97SN	Power/1553 Bus
Z	J4	NATC00T15N97SA	Power/Ethernet
Notes	1. Integrated rack connector part numbers are listed in the appropriate sections of SSP 57001. 2. UOP connector architecture is specified in SSP 57001, paragraph 3.2.7.1.		
SUP			
AA	J1	NATC00T15N97SN	Power/Data
AB	J2	NATC00T15N97SN	Power/Data
AC	J3	NATC00T15N97SN	Power
AD	J4 (SUP – 1 & 4 only)	NATC00T15N35SN	APM Payload 1553 Bus
AE	J5	NATC00T11N35SN	APM IEEE 802.3 Nominal LAN
AF	J6 (SUP – 1 & 4 only)	NATC00T15N97SN	Video/High Rate Data
AG	J7 (SUP – 1 & 4 only)	NATC00T13N35SA	Smoke Sensor/EWACS
AH	J8	Reserved	Reserved
AI	J9	NATC00T11N35SN	APM IEEE 802.3 Redundant LAN

3.2.7.1.4.2 Umbilical Physical Mate

MIDAS shall provide a Utility Panel and umbilicals that allow connection of rack utilities from the MIDAS/MARES to the standoff Utility Interface Panel defined in

SSP 41002, Figure 3.2.2-1 and the appropriate Utility Interface Panel connector layout defined in SSP 41002 Figures 3.3-1 through 3.3-5. **[SSP 57000E, paragraph 3.1.1.6.2]**

3.2.7.2 Electrical Power Interface Requirements

Electrical power characteristics are specified in this section for two interfaces, Interfaces B and C, as depicted in Figure 3.2.1–1, Electrical Power System Interface Locations, of SSP57000E. Integrated racks, payload associated hardware and payload hardware connected to Utility Outlet Panels (UOPs) in the USL, JEM, and CAM or the Standard Utility Panels (SUP) in the APM are required to be compatible with the prescribed characteristics of the Electrical Power System (EPS). For purposes of this specification, compatibility is defined as operating without producing an unsafe condition or one that could result in damage to ISS equipment or payload hardware. **[SSP 57000E, paragraph 3.2.1]**

3.2.7.2.1 Steady-State Voltage Characteristics

3.2.7.2.1.1 Interface B

The MIDAS at Interface B shall operate and be compatible with the steady-state voltage limits of 116 to 126 Vdc. **[SSP 57000E, paragraph 3.2.1.1.1]**

3.2.7.2.1.2 Interface C

The MIDAS at Interface C shall operate and be compatible with the steady-state voltage limits of 113 to 126 Vdc. **[SSP 57000E, paragraph 3.2.1.1.2]**

3.2.7.2.2 Ripple Voltage Characteristics

3.2.7.2.2.1 Ripple Voltage and Noise

The MIDAS shall operate and be compatible with the EPS time domain ripple voltage and noise level of 2.5 Vrms maximum within the frequency range of 30 Hz to 10 kHz. **[SSP 57000E, paragraph 3.2.1.2.1]**

3.2.7.2.2.2 Ripple Voltage Spectrum

The MIDAS shall operate and be compatible with the EPS ripple voltage spectrum as shown in Figure 3.2.1.2.2–1 of SSP 57000E. **[SSP 57000E, paragraph 3.2.1.2.2]**

Note: This limit is 6 dB below the EMC CS-01, 02 requirement in SSP 30237 up to30 MHz.

3.2.7.2.3 Transient Voltages

3.2.7.2.3.1 Interface B

The EPCE at Interface B shall operate and be compatible with the limits of magnitude and duration for the voltage transients at Interface B as shown in Figure 3.2.1.3.1–1 of SSP57000E. The envelope shown in this figure applies to the transient responses exclusive of any periodic ripple and/or random noise components that may be present. **[SSP 57000E, paragraph 3.2.1.3.1]**

Note: APM EPS transients less than 100 microseconds are defined in COL–RQ–ESA–014, paragraphs 4.1.5.3 and 4.1.7.2 . (in compliance with CS06 requiring a 10 ms pulse injection). Payloads meeting CS06 requirements in SSP 30237 are in compliance with the APM requirements.

3.2.7.2.3.2 Interface C

The EPCE at Interface C shall operate and be compatible with the limits of magnitude and duration for the voltage transients at Interface C as shown in Figure 3.2.1.3.2–1 of SSP57000E. The envelope shown in this Figure applies to the transient responses exclusive of any periodic ripple or noise components that may be present. **[SSP 57000E, paragraph 3.2.1.3.2]**

Note: APM EPS transients less than 100 microseconds are defined in COL–RQ–ESA–014, paragraphs 4.1.5.3 and 4.1.7.2 . (in compliance with CS06 requiring a 10 ms pulse injection). Payloads meeting CS06 requirements in SSP 30237 are in compliance with the APM requirements.

3.2.7.2.4 Fault Clearing and Protection

The MIDAS shall be safe and not suffer damage with the transient voltage conditions that are within the limits shown in Figure 3.2.1.3.3–1 of SSP 57000E. Loads may be exposed to transient overvoltage conditions during operation of the power system's fault protection components. **[SSP 57000E, paragraph 3.2.1.3.3]**

3.2.7.2.5 Non-Normal Voltage Range

The MIDAS shall not produce an unsafe condition or one that could result in damage to ISS equipment or payload hardware with the following non-normal voltage characteristics**:**

A. Maximum overvoltage of + 165 Vdc for 10 sec. **[SSP 57000E, paragraph 3.2.1.3.4.A]**

B. Undervoltage conditions of +102 Vdc for an indefinite period of time. **[SSP 57000E, paragraph 3.2.1.3.4.B]**

3.2.7.2.6 Connectors and Pin Assignments

A. Not applicable to MIDAS.

B. MIDAS connectors to UIP shall meet the pin out interfaces of the UIP connector J2 as specified in SSP 57001, paragraph 3.2.1.1. **[SSP 57000E, paragraph 3.2.2.1.B]**

C. MIDAS connectors to UIP shall meet the requirements of SSQ 21635 or equivalent. **[SSP 57000E, paragraph 3.2.2.1.C]**

D. Not applicable to MIDAS.

E. MIDAS connectors to UOP shall meet the pin out interfaces of the UOP connectors J3 and J4 as specified in SSP 57001, paragraph 3.2.1.2. **[SSP 57000E, paragraph 3.2.2.1.E]**

F. MIDAS connectors to UOP shall meet the requirements of SSQ 21635 or equivalent. **[SSP 57000E, paragraph 3.2.2.1.F]**

3.2.7.2.7 Power Bus Isolation

A MIDAS shall provide a minimum of 1-megohm isolation in parallel with not more than 0.03 microfarads of mutual capacitance within internal and external rack Electrical Power Consuming Equipment (EPCE) at all times such that no single failure shall cause the independent power buses to be electrically tied. [Mutual capacitance is defined as line-to-line capacitance, exclusive of the Electromagnetic Interference (EMI) input filter.] [SSP 57000E, paragraph 3.2.2.2.A]

B. The MIDAS internal and external EPCE shall not use diodes to electrically tie together independent ISS power bus high side or return lines. These requirements apply to both supply and return lines. **[SSP 57000E, paragraph 3.2.2.2.B]**

ISS provides the capability to support simultaneous use of Main (J1) and Auxiliary (J2) power at each ISPR location (except MPLM). Constrained element level payload operations may occur from individual payload racks that automatically switch to or require simultaneous use of auxiliary power. ISS is required to reserve the maximum auxiliary power needed on that channelized Bus (even when not in use) to prevent Bus overload. For this reason, auxiliary power feeds will nominally be powered off by the module Remote Power Controller (RPC). Specific constraints on the use of auxiliary power will be defined in the payload unique ICD.

3.2.7.2.8 Compatibility With Soft Start/Stop RPC

MIDAS shall initialize with the soft start/stop performance characteristics when power is applied, sustained, and removed by control of remote power control switches. The soft start/stop function, active only when the Remote Power

Controller (RPC) is commanded on or off, is limited to 100 amps/ms, or less, by the RPC output. The response of the soft start/stop function is linear for resistive loads for 1 to 10 ms for U.S. LAB feeds, 1 to 2 ms for JEM main, and 0.2 ms for JEM 10 amp auxiliary feeds, and 1 to 5 ms for APM feeds between 0 amp and rated current level. **[SSP 57000E, paragraph 3.2.2.3]**

3.2.7.2.9 Surge Current

The MIDAS surge current at the power inputs shall not exceed the surge current values defined in Figures 3.2.2.4–1 and 3.2.2.4–2 of SSP 57000E when powered from a voltage source with characteristics specified in paragraphs 3.2.7.2 and 3.2.7.2.8, with the exception that the source impedance is considered to be 0.1 ohm. The duration of the surge current shall not exceed 10 ms. These requirements apply to all operating modes and changes including power-up and power-down. **[SSP 57000E, paragraph 3.2.2.4]**

3.2.7.2.10 Reverse Energy/Current

The MIDAS electrical interface main input power and auxiliary input power shall comply with the requirements defined in Table 3.2.2.5–1 of SSP57000E for the reverse energy/current into the upstream power source. The MIDAS interface shall meet either the reverse energy or the reverse current requirement for all environmental conditions specified in this document when powered from a voltage source with characteristics specified in paragraphs 3.2.7.2 with a source impedance of 0.1 ohm. [SSP 57000E, paragraph 3.2.2.5]

3.2.7.2.11 Remote Power Controllers (RPCS)

A. The MIDAS shall operate and be compatible with characteristics in Figures 3.2.6–3 and 3.2.6–4 as described in paragraph 3.2.6 located in SSP 57001. **[SSP 57000E, paragraph 3.2.2.6.1.1.A]**

B. Overcurrent protection shall be provided at all points in the system where power is distributed to lower level (wire size not protected by upstream circuit protection device) feeder and branch lines. **[SSP 57000E, paragraph 3.2.2.6.1.1.D]**

C. MIDASs shall provide current limiting overcurrent protection for all internal loads (exclusive of overcurrent protection circuits and devices) drawing power from an interface B power feed. For the purpose of this requirement, internal overcurrent protection circuits and devices are not considered to be loads. **[SSP 57000E, paragraph 3.2.2.6.1.1.E]**

D. MIDAS circuit protection device trip ratings shall be coordinated with the upstream RPC trip characteristics so that an event that activates protection in a downstream device will not also trip the one upstream. **[SSP 57000E, paragraph 3.2.2.6.2.1.1]**

E. The MIDAS connected to a UOP shall operate and be compatible with the characteristics in Figure 3.2.6–5 as described in paragraph 3.2.6 located in SSP 57001. **[SSP 57000E, paragraph 3.2.2.6.1.1.C]**

3.2.7.2.11.1 MIDAS Trip Requirements Summary:

A. The Midas shall trip at a current greater than or equal to 10 amps for 19+/- 1msec

B. The Midas shall limit the fault current to less than 12 amps.

C. The Midas shall achieve current limit within 1 millisecond.

The above three requirements satisfies all trip requirements for the following power interfaces listed in Table 3.2.7.2.11.1-1.

The Power Interface Panel (PIP) does not satisfy power interfaces with trip requirements less than 12 amps. These power interfaces are listed in Table 3.2.7.2.11.1-2.

TABLE 3.2.7.2.11.1-1. PIP COMPATIBLE POWER INTERFACES.

Type of RPCM	Minimum trip level amps	Minimum trip time msec	Current limiting
US. RPCM type I (UOP)	13.2	31.1	Y
US. RPCM type V	13.2	31.1	Y
JEM RPCM PDU 10	15.8	45	Y
JEM RPCM PDU 10	17	10	Y
JEM RPCM PDU 10 CL	17	20	Y
APMSSPC 10A aux	18	1.5	Y
APMSSPC 10A aux CL	18	1.5	Y
SUP	18	12	Y
JEM RPCM PDB 10A CL	20	12.75	Y
APMSSPC sup 10A CL	26.1	1.5	Y
US. RPCM type II	27.5	31.1	Y
US. RPCM type VI	27.5	40.1	N
APMSSPC 25A	36	1.5	Y
APMSSPC 10A 12kw	36	1.5	Y
APMSSPC 25A CL	36	1.5	Y
APMSSPC 10A 12kw CL	36	1.5	Y
JEM RPCM PDU 25	42.1	10	Y
JEM RPCM PDU 25 CL	42.1	17	Y
JEM RPCM PDU 25	42.5	45	Y
US. RPCM type VI	47.5	1.1	N
US. RPCM type III	54.5	40.1	N
US. RPCM type IV	65	26	N
APMSSPC 50A	72	1.5	Y
APMSSPC 50A CL	72	1.5	Y
JEM RPCM PDU 50	80	45	Y
JEM RPCM PDU 50	85	10	Y
JEM RPCM PDU 50 CL	85	10	Y
US. RPCM type III	95	1.1	N
US. RPCM type VI	125	0.11	N
US. RPCM type III	250	.11	N
SUP	18	12	Y
JEM RPCM PDB 10A CL	20	12.75	Y

TABLE 3.2.7.2.11.1-2. PIP NON-COMPATIBLE POWER INTERFACES

Type of RPCM	Minimum trip level amps	Minimum trip time msec	Current limiting
JEM RPCM PDB 1.5A	2.55	10	Y
US RPCM type V 3.5 amp	3.8	13.2	Y
JEM RPCM PDB 5A	8.5	10	Y
JEM RPCM PDB 10A	10	12.75	Y
JEM RPCM PDB 10A	11.9	500	Y
JEM RPCM PDB 10A CL	12.75	10	Y

3.2.7.2.12 Rack Complex Load Impedances

3.2.7.2.12.1 Interface B

The load impedance presented by the MIDAS to the 1.2 to 1.44 kW interface B shall not exceed the bounds defined by Figure 3.2.2.7.1–3 of SSP57000E for input over the frequency range of 50 Hz to 100 kHz. The magnitude component of the MIDAS input impedance should not be less than the minimum defined in Figure 3.2.2.7.1–3 of SSP57000E. At frequencies where the magnitude component of the MIDAS input impedance is less than the defined minimum, the phase component of the input impedance shall not exceed the bounds defined in this Figure. **[SSP 57000E, paragraph 3.2.2.7.1.B]**

3.2.7.2.12.2 Interface C

The load impedance presented to Interface C shall not exceed the bounds defined by Figure 3.2.2.7.2–1 of SSP57000E for input over the frequency range of 50 Hz to 100kHz. The magnitude component of the EPCE input impedance should not be less than the minimum defined in Figure 3.2.2.7.2–1 of SSP57000E. At frequencies where the magnitude component of the EPCE input impedance is less than the defined minimum, the phase component of the input impedance shall not exceed the bounds defined in this Figure. **[SSP 57000E, paragraph 3.2.2.7.2]**

3.2.7.2.13 Large Signal Stability

The MIDAS shall maintain stability with the ISS EPS interface by damping a transient response to 10 percent of the maximum response amplitude within 1.0 ms, and remaining below 10 percent thereafter under the following conditions:

1. The rise time/fall time (between 10 and 90 percent of the amplitude) of the input voltage pulse is less than 10 microseconds (μs). **[SSP 57000E, paragraph 3.2.2.8.1]**

2. The voltage pulse is to be varied from 100 to 150 μs in duration. **[SSP 57000E, paragraph 3.2.2.8.2]**

Note: Figure 3.2.2.8–1 of SSP 57000E is used to clarify the above requirement.

3.2.7.2.14 Deleted

3.2.7.2.15 Electrical Load-Stand Alone Stability

The MIDAS shall provide local stability by meeting the following conducted susceptibility requirements defined in Paragraph 3.2.7.2.19.4: **[SSP 57000E, paragraph 3.2.2.10]**

A. Paragraph 3.2.2.1 of SSP 30237 (CS01)

B. Paragraph 3.2.2.2 of SSP 30237 (CS02)

C. Paragraph 3.2.2.3 of SSP 30237 (CS06)

3.2.7.2.16 Wire Derating

A. Derating criteria for EPCE at and downstream of the primary circuit protection device(s) in the MIDAS, as shown in Figure 3.2.3.1–1 of SSP 57000E, shall be per NASA Technical Memo (TM) 102179 as interpreted by NSTS 18798, TA-92-038. **[SSP 57000E, paragraph 3.2.3.1.B]**

B. MIDASs shall use 4 gauge wire for main and auxiliary connections at the UIP. **[SSP 57000E, paragraph 3.2.3.1.C]**

C. Wire derating for wire/cable between EPCE and the UOP shall be in accordance with SSP 30312. **[SSP 57000E, paragraph 3.2.3.1.A]**

3.2.7.2.17 Exclusive Power Feeds

A. The MIDAS shall receive power only from the UIP dedicated to its rack location. **[SSP 57000E, paragraph 3.2.3.2.A]**

B. Cabling shall not occur between Interface C connected EPCE with Interface B; and/or Interface B connected EPCE with Interface C. **[SSP 57000E, paragraph 3.2.3.2.B]**

3.2.7.2.18 Loss of Power

The MIDAS shall fail safe in the event of a total or partial loss of power regardless of the availability of Auxiliary power in accordance with NSTS 1700.7B, ISS Addendum. **[SSP 57000E, paragraph 3.2.3.3]**

3.2.7.2.19 Electromagnetic Compatibility

The MIDAS shall meet the payload provider applicable requirements of SSP 30243, paragraphs 3.1, 3.5, and 3.6.2. **[SSP 57000E, paragraph 3.2.4]**

3.2.7.2.19.1 Electrical Grounding

The MIDAS shall meet all requirements specified in section 3 of SSP 30240. **[SSP 57000E, paragraph 3.2.4.1]**

3.2.7.2.19.2 Electrical Bonding

MIDAS shall interface with the module bond strap per SSP 57001 Hardware ICD Template. Electrical bonding of MIDAS to Interface B shall be in accordance with SSP 30245 and NSTS 1700.7B, ISS Addendum sections 213 and 220. **[SSP 57000E, paragraph 3.2.4.2]**

3.2.7.2.19.3 Cable/Wire Design and Control Requirements

MIDAS cabling shall meet all Cable and Wire Design requirements of SSP 30242. **[SSP 57000E, paragraph 3.2.4.3]**

3.2.7.2.19.4 Electromagnetic Interference

A. MIDASs shall meet all EMI requirements of SSP 30237. **[SSP 57000E, paragraph 3.2.4.4]**

Note: The alternative use of RS03 stated below applies to radiated susceptibility requirements only.

B. Alternately, MIDASs may choose to accept a minimal increase of EMI risk with a somewhat less stringent Electric Field Radiated Susceptibility (RS03) requirement on equipment considered to be non-safety critical to the vehicle and crew. The tailored RS03 requirement, shown below, will hereafter be denoted RS03PL.

FREQUENCY	**RS03PL LIMIT (V/m)**
14 kHz – 400 MHz	5
400 MHz – 450 MHz	30
450 MHz – 1 GHz	5
1 GHz – 5 GHz	25
5 GHz – 6 GHz	60
6 GHz – 10 GHz	19
13.7 GHz – 15.2 GHz	25

COMMENTS: The less stringent RS03PL limit was developed to envelope the electric fields generated by ISS transmitters and ground-based radars tasked to perform space surveillance and tracking. Ground-based radars that are not tasked to track the ISS and search radars that could momentarily sweep over the ISS are not enveloped by the relaxed RS03PL. For most scientific payloads, the minimal increase of EMI risk for the reduced limits is acceptable. The RS03PL limit does not account for module electric field shielding effectiveness that could theoretically reduce the limits even more. Although shielding effectiveness exists, it is highly dependent on the EPCE location within the module with respect to ISS windows.

3.2.7.2.19.5 Alternating Current (AC) Magnetic Fields

The generated ac magnetic fields, measured at a distance of 7 centimeters (cm) from the generating equipment, shall not exceed 140 dB above 1 picotesla for

frequencies ranging from 30 Hz to 2 kHz, then falling 40 dB per decade to 50 kHz. **[SSP 57000E, paragraph 3.2.4.6]**

3.2.7.2.19.6 Direct Current (DC) Magnetic Fields

The generated DC magnetic fields shall not exceed 170 dB picotesla at a distance of 7 cm from the generating equipment. This applies to electromagnetic and permanent magnetic devices. **[SSP 57000E, paragraph 3.2.4.7]**

3.2.7.2.20 Electrostatic Discharge

Unpowered EPCE and components shall not be damaged by Electrostatic Discharge (ESD) equal to or less than 4,000 V to the case or any pin on external connectors. EPCE that may be damaged by ESD between 4,000 and 15,000 V shall have a label affixed to the case in a location clearly visible in the installed position. Labeling of EPCE susceptible to ESD up to 15,000 V shall be in accordance with MIL–STD–1686. These voltages are the result of charges that may be accumulated and discharged from ground personnel or crewmembers during equipment installation or removal. **[SSP 57000E, paragraph 3.2.4.5]**

3.2.7.2.21 Corona

MIDAS electrical and electronic subsystems, equipment, and systems shall be designed to preclude damaging or destructive corona in its operating environment. Guidance for meeting the corona requirement is found in MSFC–STD–531, High Voltage Design Criteria. **[SSP 57000E, paragraph 3.2.4.8]**

3.2.7.2.22 Lightning

The MIDAS shall meet the lightning induced environment requirement in paragraph 3.2.8.1 of SSP 30243. **[SSP 57000E, paragraph 3.2.4.9]**

3.2.7.3 Command and Data Handling Interface Requirements

Not applicable to MIDAS.

3.2.7.4 Payload National Television Standards Committee (NTSC) Video Interface Requirements

Not applicable to MIDAS.

3.2.7.5 Thermal Control Interface Requirements

Not Applicable to MIDAS.

3.2.7.6 Vacuum System Requirements

Not applicable to MIDAS.

3.2.7.7 Pressurized Gas Interface Requirements

Not applicable to MIDAS.

3.2.7.8 Fluid System Servicer

Not applicable to MIDAS.

3.2.7.9 Fire Protection Interface Requirements

3.2.7.9.1 Fire Prevention

MIDAS shall meet the fire prevention requirements specified in NSTS 1700.7B, ISS Addendum, paragraph 220.10a. **[SSP 57000E, paragraph 3.10.1]**

3.2.7.9.2 Payload Monitoring and Detection Requirements

Not applicable to MIDAS

3.2.7.9.3 Fire Suppression

Not applicable to MIDAS.

3.2.7.9.4 Labeling

Not applicable to MIDAS

3.2.7.10 Other Interface Requirements

Not applicable to MIDAS.

3.3 DESIGN AND CONSTRUCTION

3.3.1 Materials, Processes, and Parts

3.3.1.1 Materials and Processes

3.3.1.1.1 Materials and Parts Use and Selection

The **MIDAS** shall use materials and parts that meet the materials requirements specified in NSTS 1700.7B, ISS Addendum, Section 209. **[SSP 57000E, paragraph 3.11.1]**

3.3.1.1.1.1 Russian Materials Usage Agreement

A. Materials shall comply with the "Agreement on the Safe Utilization of Materials in Cargos to be Delivered to ISS by Any Vehicle and Transferred to ISS for Stowage and/or Operation" dated 6/22/2000.

B. Fiberglass cloth tape shall not be used in HRF payloads that may be carried into the ISS Russian segment. (Materials and Processes Technology Branch)

3.3.1.1.2 Commercial Parts

Commercial off the Shelf (COTS) parts used in the **MIDAS** shall meet the materials requirements specified in NSTS 1700.7B, ISS Addendum, Section 209. **[SSP 57000E, paragraph 3.11.1.1]**

3.3.1.1.3 Fluids

Not applicable to MIDAS.

3.3.1.1.4 Cleanliness

MIDAS shall conform to Visibly Clean-Sensitive (VC–S) cleanliness requirements as specified in SN–C–0005. **[SSP 57000E, paragraph 3.11.3]**

3.3.1.1.5 Fungus Resistant Material

MIDAS shall use fungus resistant materials according to the requirements specified in SSP 30233, paragraph 4.2.10. **[SSP 57000E, paragraph 3.11.4]**

3.3.1.2 Sharp Edges and Corners Protection

Payload design within a pressurized module shall protect crewmembers from sharp edges and corners during all crew operations in accordance with NSTS 1700.7, ISS Addendum, paragraph 222.1. **[SSP 57000E, paragraph 3.12.9.2]**

3.3.1.3 Holes

Holes that are round or slotted in the range of 10.0 to 25.0 mm (0.4 to 1.0 in.) shall be covered. **[SSP 57000E, paragraph 3.12.9.4]**

3.3.1.4 Latches

Latches that pivot, retract, or flex so that a gap of less than 35 mm (1.4) exists shall be designed to prevent entrapment of a crewmember's appendage. **[SSP 57000E, paragraph 3.12.9.4]**

3.3.1.5 Screws and Bolts

Threaded ends of screws and bolts accessible by the crew and extending more than 3.0 mm (0.12 in) shall be capped to protect against sharp threads. **[SSP 57000E, paragraph 3.12.9.5]**

3.3.1.6 Securing Pins

Securing pins shall be designed to prevent their inadvertently backing out above the handhold surface. **[SSP 57000E, paragraph 3.12.9.6]**

3.3.1.7 Levers, Cranks, Hooks, and Controls

Levers, cranks, hooks, and controls shall not be located where they can pinch, snag, or cut the crewmembers or their clothing. **[SSP 57000E, paragraph 3.12.9.7]**

3.3.1.8 Burrs

Exposed surfaces shall be free of burrs. **[SSP 57000E, paragraph 3.12.9.8]**

3.3.1.9 Locking Wires

Not applicable to MIDAS.

3.3.2 Nameplates and Product Marking

3.3.2.1 Equipment Identification

Integrated racks, all (installed in the rack or separately) sub-rack elements, loose equipment, stowage trays, consumables, ORUs, crew accessible connectors and cables, switches, indicators, and controls shall be labeled. Labels are markings of any form [including Inventory Management System (IMS) bar codes] such as decals and placards, which can be adhered, "silk screened," engraved, or otherwise applied directly onto the hardware. Appendix C of SSP 57000 provides instructions for label and decal design and approval. **[SSP 57000E, paragraph**

3.12.7]

3.3.3 Workmanship

Workmanship shall be in accordance with approved NASA and industry recognized standards. (LS-71000A, Section 7.3.1)

3.3.4 Interchangeability

The MIDAS hardware will be built to flight released drawings. This will ensure interchangeability among each subassembly.

3.3.5 Safety Requirements

3.3.5.1 EMI Susceptibility for Safety-Critical Circuits

Not applicable to MIDAS.

3.3.5.2 Payload Electrical Safety

3.3.5.2.1 Mating/Demating of Powered Connectors

EPCE shall meet the electrical safety requirements as defined in NSTS 1700.7 Addendum. Payloads shall comply with the requirements for mating/demating of powered connectors specified in NSTS 18798, MA2-97-093. **[SSP 57000E, paragraph 3.2.5.1.1]**

Note: The module can provide one verifiable upstream inhibit which removes voltage from the UIP and UOP connectors. The module design will provide the verification of the inhibit status at the time the inhibit is inserted.

3.3.5.2.2 Safety-Critical Circuits Redundancy

Not applicable to MIDAS.

3.3.5.2.3 Power Removal Switch

Not applicable to MIDAS.

3.3.5.2.4 Power Switches/Controls

A. Switches/controls performing on/off power functions for all power interfaces shall open (dead-face) all supply circuit conductors except the power return and the equipment grounding conductor while in the power-off position. **[SSP 57000E, paragraph 3.2.5.3.A]**

B. Power-off markings and/or indications shall be used only if all parts, with the exception of overcurrent devices and associated EMI filters, are disconnected

from the supply circuit. **[SSP 57000E, paragraph 3.2.5.3.B]**

C. Not applicable to MIDAS.

3.3.5.2.5 Portable Equipment/Power Cords

A. Non-battery powered portable equipment shall incorporate a three-wire power cord; e.g., a 120 volt supply lead (+), a 120 volt return (–) lead and a safety (green) wire, one end connected to the portable equipment chassis (and all exposed conductive surfaces) and the other end connected to structure at the GFCI location through the GFCI interface. A system of double insulation or its equivalent, when approved by NASA, may be used without a ground wire. **[SSP 57000E, paragraph 3.2.5.5.A]**

B. Not applicable to MIDAS.

3.3.6 Human Engineering

3.3.6.1 Closures or Covers Design Requirements

Closures or covers shall be provided for any area of the payload that is not designed for routine cleaning.

3.3.6.2 Interior Color

Payloads shall select interior colors in accordance with the requirements in Table 3.2.5.3–1. [SSP57000E, paragraph 3.12.8]

3.3.6.2.1 Rack Mounted Equipment

A. SSP 50008, Rev. A, page 3-4, Table 3.2.7.1, applies to MIDAS mounted hardware. Front panels for active and stowage drawers meant for installation in MIDAS shall be off-white, specification #27722 as given in FED-STD-595B, "Federal Standard Colors Used in Government Procurement." (LS-71000A, Section 6.4.3.5.1)

B. The finish shall be semi-gloss. (LS-71000A, Section 6.4.3.5.1)

C. Not applicable to MIDAS.

3.3.6.2.2 Stowed/Deployable Equipment

The colors and finishes for stowed and deployable equipment, even if it is normally attached to the rack during use shall be as specified below:

A. COTS equipment that is not repackaged by HRF engineers shall be finished as delivered by the manufacturer. (LS-71000A, Section 6.4.3.5.2A)

B. Items that are repackaged by HRF engineers shall be finished using anodic film per MIL-A-8625, Type II, Class 2, Dyed Turquoise. Reference FED-STD-595, Color Specification 15187. (LS-71000A, Section 6.4.3.5.2B)

3.3.6.2.3 Colors for Soft Goods

Human factors engineering will provide guidance in the appropriate colors for soft goods, in cooperation with the lead engineers, who will provide data on the available color choices for the specified materials. (LS-71000A, Section 6.4.3.5.3)

3.3.6.3 Full Size Range Accommodation

All payload workstations and hardware having crew nominal operations and planned maintenance shall be sized to meet the functional reach limits for the 5th percentile Japanese female and yet shall not constrict or confine the body envelope for the 95th percentile American male as specified in SSP 50005, Section 3. (LS-71000A, Section 6.4.2.3)

3.3.6.4 Operation and Control of Payload Equipment

A. Grip Strength

To remove, replace and operate payload hardware, grip strength required shall be less than 254 N (57 lbf). (LS-71000A, Section 6.4.1.1A)

B. Linear Forces

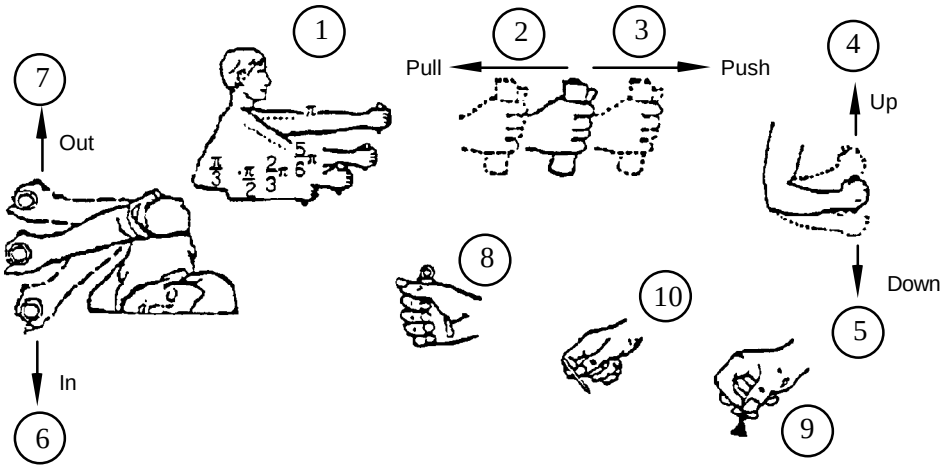
Linear forces required to operate or control payload hardware or equipment shall be less than the strength values for the 5th percentile female, defined as 50% of the strength values shown in Figure 3.3.6.4-1 and 60% of the strength values shown in Figure 3.3.6.4-2. (LS-71000A, Section 6.4.1.1B)

C. Torque

Torque required to operate or control payload hardware or equipment shall be less than the strength values for the 5th percentile female, defined as 60% of the calculated 5th percentile male capability shown in Figure 3.3.6.4-3. (LS-71000A, Section 6.4.1.1C)

3.3.6.5 Maintenance Operations

Forces required for maintenance of payload hardware and equipment shall be less than the 5th percentile male strength values shown in Figures 3.3.6.4-1, 3.3.6.4-2, 3.3.6.4-3, 3.3.6.5-1, and 3.3.6.5-2. (LS-71000A, Section 6.4.1.2)



Arm Strength (N)												
(1)	(2)		(3)		(4)		(5)		(6)		(7)	
Degree of elbow flexion (rad)	Pull		Push		Up		Down		In		Out	
	L**	R**	L	R	L	R	L	R	L	R	L	R
p	222	231	187	222	40	62	58	76	58	89	36	62
5/6 p	187	249	133	187	67	80	80	89	67	89	36	67
2/3 p	151	187	116	160	76	107	93	116	89	98	45	67
1/2 p	142	165	98	160	76	89	93	116	71	80	45	71
1/3 p	116	107	96	151	67	89	80	89	76	89	53	76
Hand and thumb-finger strength (N)												
	(8)				(9)				(10)			
	Hand Grip											
	L		R		Thumb-finger grip (Palmer)				Thumb-finger grip (tips)			
Momentary hold	250		260		60				60			
Sustained hold	145		155		35				35			
*Elbow angle shown in radians **L = Left, R = Right												
Arm strength (lb)												
(1)	(2)		(3)		(4)		(5)		(6)		(7)	
Degree of elbow flexion (deg)	Pull		Push		Up		Down		In		Out	
	L	R*	L	R	L	R	L	R	L	R	L	R
180	50	52	42	50	9	14	13	17	13	20	8	14
150	42	56	30	42	15	18	18	20	15	20	8	15
120	34	42	26	36	17	24	21	26	20	22	10	15
90	32	37	22	36	17	20	21	26	16	18	10	16
60	26	24	22	34	15	20	18	20	17	20	12	17
Hand and thumb-finger strength (lb)												
	(8)				(9)				(10)			
	Hand Grip											
	L		R		Thumb-finger grip (Palmer)				Thumb-finger grip (tips)			
Momentary hold	56		59		13				13			
Sustained hold	33		35		8				8			
*Left; R = Right												

Figure 3.3.6.4-1. Arm, Hand and Thumb/Finger Strength (5th Percentile Male Data)

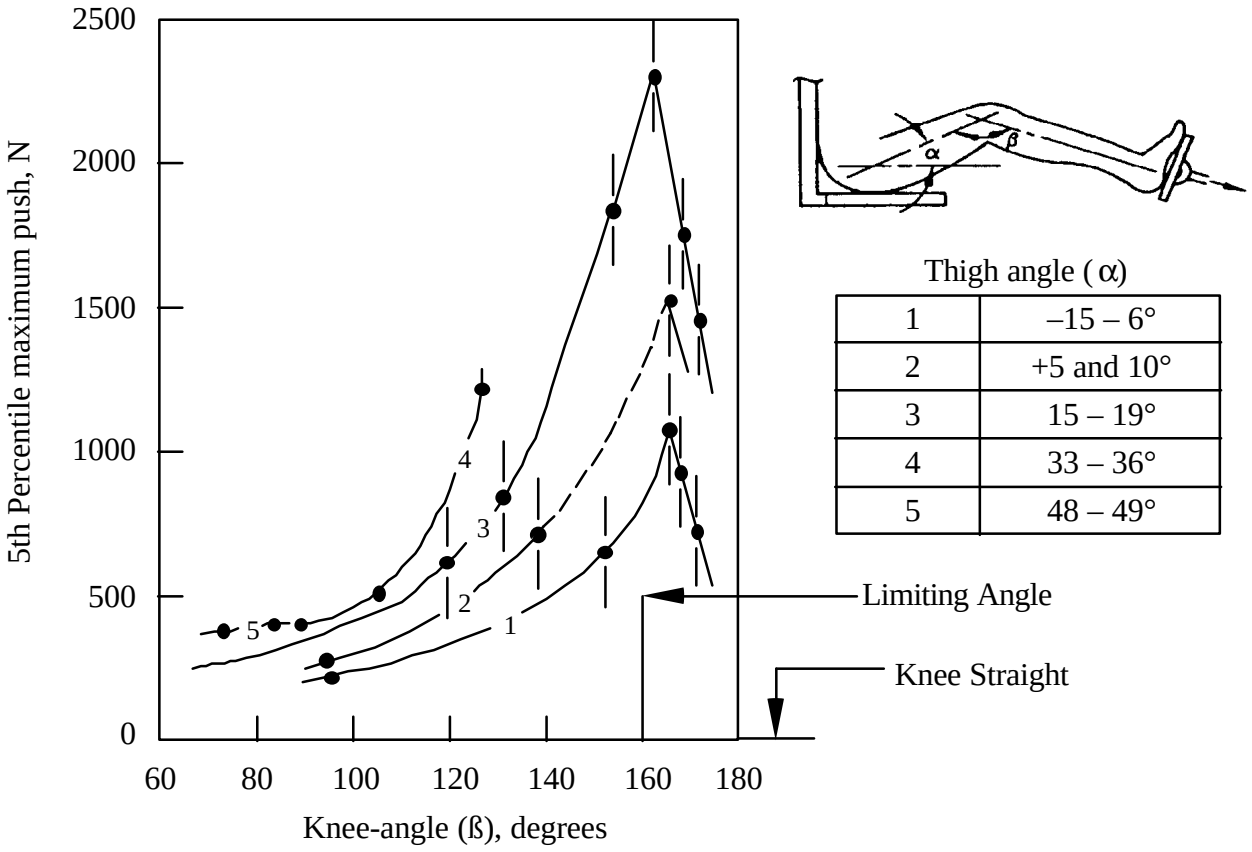


Figure 3.3.6.4-2. Leg Strength at Various Knee and Thigh Angles (5th Percentile Male Data)

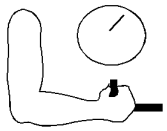
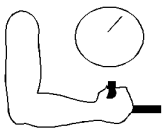
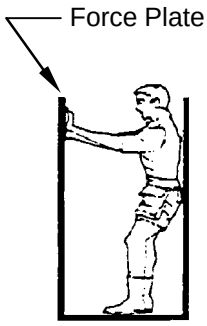
	Unpressurized suit, bare handed	
	Mean	SD
 Maximum torque: Suppination, Nm (lb-in.)	13.73 (121.5)	3.41 (30.1)
 Maximum torque: Pronation, Nm (lb-in.)	17.39 (153.9)	5.08 (45.0)

Figure 3.3.6.4-3. Torque Strength

	Force-plate (1) height	Distances (2)	Force, N (lbf) Means	Force, N (lbf) SD
			Both hands	
	100 percent of shoulder height	50	583 (131)	142 (32)
		60	667 (150)	160 (36)
		70	983 (221)	271 (61)
		80	1285 (289)	400 (90)
		90	979 (220)	302 (68)
		100	645 (145)	254 (57)
			Preferred hand	
		50	262 (59)	67 (15)
		60	298 (67)	71 (16)
		70	360 (81)	98 (22)
		80	520 (117)	142 (32)
		90	494 (111)	169 (38)
		100	427 (96)	173 (39)
		Percent of thumb-tip reach*		
	100 percent of shoulder height	50	369 (83)	138 (31)
		60	347 (78)	125 (28)
		70	520 (117)	165 (37)
		80	707 (159)	191 (32)
		90	325 (73)	133 (30)
		Percent of span**		
	Force-plate (1) height	Distances (2)	Force, N (lbf) Means	Force, N (lbf) SD
	50	100	774 (174)	214 (48)
	50	120	778 (175)	165 (37)
	70	120	818 (184)	138 (31)
	Percent of shoulder height		1-g applicable data	

NOTES:

(1) Height of the center of the force plate - 200 mm (8 in) high by 254 mm (10 in) long - upon which force is applied.

(2) Horizontal distance between the vertical surface of the force plate and the opposing vertical surface (wall or footrest, respectively) against which the subject brace themselves.

(3) Thumb-tip reach - distance from backrest to tip of subject's thumb as thumb and fingertips are pressed together.

(4) Span - the maximal distance between a person's fingertips as he extends his arms and hands to each side.

(5) 1-g data.

Figure 3.3.6.5-1. Maximal Static Push Forces

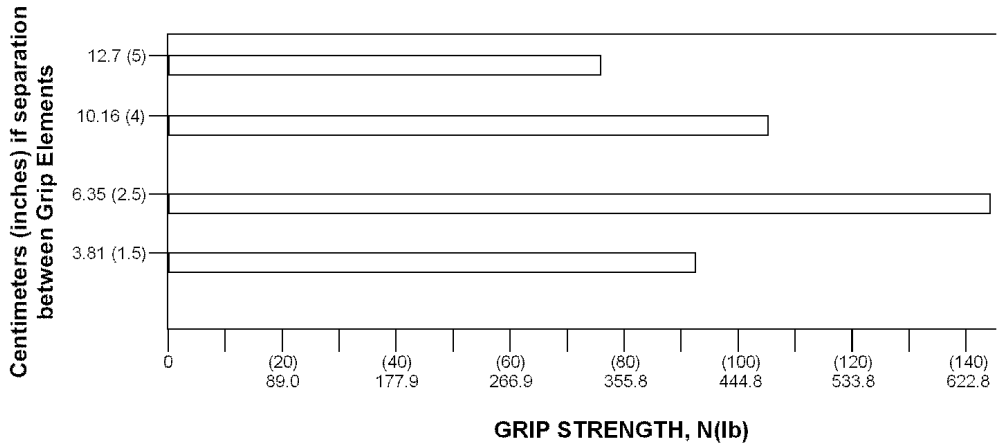


Figure 3.3.6.5-2. Male Grip Strength as a Function of the Separation Between Grip Elements

3.3.6.6 Adequate Clearance

The payloads shall provide clearance for the crew to perform installation, operations and maintenance tasks, including clearance for hand access, tools and equipment used in these tasks. (LS-71000A, Section 6.4.2.1)

3.3.6.7 Accessibility

A. Payload hardware shall be geometrically arranged to provide physical and visual access for all payload installation, operations, and maintenance tasks. Payload ORUs should be removable along a straight path until they have cleared the surrounding structure. (LS-71000A, Section 6.4.2.2A)

B. IVA clearances for finger access shall be provided as given in Figure 3.3.6.7-1. (LS-71000A, Section 6.4.2.2B)

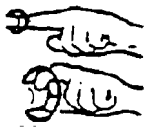
Minimal finger-access to first joint			
Push button access:	Bare hand: Thermal gloved hand:	32 mm dia (1.26 in.) 38 mm dia (1.5 in.)	
Two finger twist access:	Bare hand: Thermal gloved hand:	object plus 50 mm (1.97 in.) object plus 65 mm (2.56 in.)	

Figure 3.3.6.7-1. Minimum Sizes for Access Openings for Fingers

3.3.6.8 One-Handed Operation

Not applicable to MIDAS.

3.3.6.9 Continuous/Incidental Contact - High Temperature

When payload surfaces whose temperature exceeds 49 °C (120 °F), which are subject to continuous or incidental contact, are exposed to crewmember's bare skin contact, protective equipment shall be provided to the crew and warning labels shall be provided at the surface site. This also applies to surfaces not normally exposed to the cabin in accordance with the NASA IVA Touch Temperature Safety interpretation letter JSC, MA2-95-048. **[SSP 57000E, paragraph 3.12.3.2.1]**

3.3.6.10 Continuous/Incidental Contact - Low Temperature

Not applicable to MIDAS.

3.3.6.11 Equipment Mounting

Equipment items used during nominal operations and planned maintenance shall be designed, labeled, or marked to protect against improper installation. (LS-71000A, Section 6.4.4.2.1)

3.3.6.12 Drawers and Hinged Panels

A. Payload ORUs which are pulled out of their installed positions for routine checkout shall be mounted on equipment drawers or on hinged panels. (LS-71000A, Section 6.4.4.2.2)

B. Such drawers or hinged panels shall remain in the "open" position without being supported by hand. (LS-71000A, Section 6.4.4.2.2)**]**

3.3.6.13 Alignment

Payload hardware having blind mate connectors shall provide guide pins or their equivalent to assist in alignment of hardware during installation. (LS-71000A, Section 6.4.4.2.3)

3.3.6.14 Slide-Out Stops

Limit stops shall be provided on slide or pivot mounted MIDAS hardware, which is required to be pulled out of its installed positions. (LS-71000A, Section 6.4.4.2.4)

3.3.6.15 Push-Pull Force

Payload hardware mounted into a capture-type receptacle that requires a push-pull action shall require a force less than 156 N (35 lbf) to install or remove. (LS-71000A, Section 6.4.4.2.5)

3.3.6.16 Covers

Where physical access is required, one of the following practices shall be followed, with the order of preference given. (LS-71000A, Section 6.4.4.2.6.1)

A. Provide a sliding or hinged cap or door where debris, moisture, or other foreign materials might otherwise create a problem.

B. Provide a quick-opening cover plate if a cap will not meet stress requirements.

3.3.6.17 Self-Supporting Covers

All access covers that are not completely removable shall be self-supporting in the open position. (LS-71000A, Section 6.4.4.2.6.2)

3.3.6.18 Accessibility

It shall be possible to mate/demate individual connectors without having to remove or mate/demate other connectors during nominal operations. (LS-71000A, Section 6.4.4.3.2A)

3.3.6.19 Ease of Disconnect

Electrical connectors shall require no more than two turns to disconnect. **[SSP 57000E, paragraph 3.12.4.3.3]**

3.3.6.20 Indication of Pressure/Flow

Not applicable to MIDAS.

3.3.6.21 Self Locking

Payload electrical connectors shall provide a self-locking feature. (LS-71000A, Section 6.4.4.3.5)

3.3.6.22 Connector Arrangement

A. Space between connectors and adjacent obstructions shall be a minimum of 25 mm (1 inch) for IVA access. (LS-71000A, Section 6.4.4.3.6A)

B. Connectors in a single row or staggered rows which are removed sequentially by the crew IVA shall provide 25 mm (1 inch) of clearance from other connectors and/or adjacent obstructions for 270 degrees of sweep around each connector beginning at the start of its removal/replacement sequence. (LS-71000A, Section 6.4.4.3.6B)

3.3.6.23 Arc Containment

Electrical connector plugs shall be designed to confine/isolate the mate/demate electrical arcs or sparks. (LS-71000A, Section 6.4.4.3.7)

3.3.6.24 Connector Protection

Protection shall be provided for all demated connectors against physical damage and contamination. (LS-71000A, Section 6.4.4.3.8)

3.3.6.25 Connector Shape

Payload connectors shall use different connector shapes, sizes or keying to prevent mating connectors when lines differ in content. (LS-71000A, Section 6.4.4.3.9)

3.3.6.26 Fluid and Gas Line Connectors

Not applicable to MIDAS.

3.3.6.27 Alignment Marks or Guide Pins

Mating parts shall have alignment marks in a visible location during mating or guide pins (or their equivalent). (LS-71000A, Section 6.4.4.3.11A)

3.3.6.28 Coding

A. Both halves of mating connectors shall display a code or identifier, which is unique to that connection. (LS-71000A, Section 6.4.4.3.12A)

B. The labels or codes on connectors shall be located so they are visible when connected or disconnected. (LS-71000A, Section 6.4.4.3.12B)

3.3.6.29 Pin Identification

Each pin shall be uniquely identifiable in each electrical plug and each electrical receptacle. At least every 10th pin must be labeled. (LS-71000A, Section 6.4.4.3.13)

3.3.6.30 Orientation

Grouped plugs and receptacles shall be oriented so that the aligning pins or equivalent devices are in the same relative position. (LS-71000A, Section 6.4.4.3.14)

3.3.6.31 Hose/Cable Restraints

A. Payloads shall provide a means to restrain the loose ends of hoses and cables. (LS-71000A, Section 6.4.4.3.15A)

B. Conductors, bundles, or cables shall be secured by means of clamps unless they are contained in wiring ducts or cable retractors. (LS-71000A, Section 6.4.4.3.15B)

C. Cables should be bundled if multiple cables are running in the same direction and the bundling does not cause EMI. (LS-71000A, Section 6.4.4.3.15C)

D. Loose cables (longer than 0.33 meters (1 foot) shall be restrained as follows (LS-71000A, Section 6.4.4.3.15D):

Length (m)	Restraint Pattern (% of length) tolerances +/- 10%)
0.33-1.00	50
1.00-2.00	33,67
2.00-3.00	20, 40, 60, 80
>3.00	at least each 0.5 meters

3.3.6.32 Non-Threaded Fasteners Status Indication

An indication of correct engagement (hooking, latch fastening, or proper positioning of interfacing parts) of non-threaded fasteners shall be provided. (LS-71000A, Section 6.4.4.4.1)

3.3.6.33 Mounting Bolt/Fastener Spacing

Clearance around fasteners to permit fastener hand threading (if necessary) shall be a minimum of 0.5 inches for the entire circumference of the bolt head and a minimum of 1.5 inches over 180 degrees of the bolt head and provide the tool handle sweep as seen in Figure 3.3.6.33-1. Excepted are National Space Transportation System (NSTS) standard middeck lockers or payload-provided hardware with the static envelope dimensions (cross-section) as specified in Figures 3.4.2.1-1, 3.4.2.2-1 and 3.4.2.3-1 of NSTS-21000-IDD-MDK and other similar captive fastener arrangements. (LS-71000A, Section 6.4.4.4.2)

3.3.6.34 Multiple Fasteners

When several fasteners are used on one item they shall be of identical type. (LS-71000A, Section 6.4.4.4.3)

NOTE: Phillips or Torque-Set fasteners may be used where fastener installation is permanent relative to planned on-orbit operations or maintenance, or where tool-fastener interface failure can be corrected by replacement of the unit containing the affected fastener with a spare unit. (LS-71000, Section 6.4.4.4.3)

3.3.6.35 Captive Fasteners

All fasteners planned to be installed and/or removed on-orbit shall be captive when disengaged. (LS-71000A, Section 6.4.4.4.4)

3.3.6.36 Quick Release Fasteners

A. Quick release fasteners shall require a maximum of one complete turn to operate (quarter - turn fasteners are preferred). (LS-71000A, Section 6.4.4.4.5A)

B. Quick release fasteners shall be positive locking in open and closed positions. (LS-71000A, Section 6.4.4.4.5B)

3.3.6.37 Threaded Fasteners

Only right-handed threads shall be used. (LS-71000A, Section 6.4.4.4.6)

3.3.6.38 Over Center Latches

Not applicable to MIDAS.

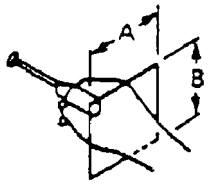
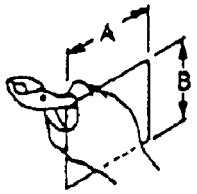
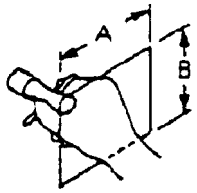
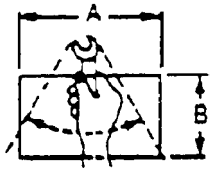
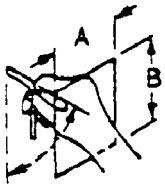
Opening dimensions		Task
	A 117 mm (4.6 in) B 107 mm (4.2 in)	Using common screwdriver with freedom to turn hand through 180°
	A 133 mm (5.2 in) B 115 mm (4.5 in)	Using pliers and similar tools
	A 155 mm (6.1 in) B 135 mm (5.3 in)	Using T-handle wrench with freedom to turn wrench through 180°
	A 203 mm (8.0 in) B 135 mm (5.3 in)	Using open-end wrench with freedom to turn wrench through 62°
	A 122 mm (4.8 in) B 155 mm (6.1 in)	Using Allen-type wrench with freedom to turn wrench through 62°

Figure 3.3.6.33-1. Minimal Clearance for Tool-Operated Fasteners

3.3.6.39 Winghead Fasteners

Not applicable to MIDAS.

3.3.6.40 Fastener Head Type

A. Hex type external or internal grip or combination head fasteners shall be used where on-orbit crew actuation is planned, e.g., ORU replacement. (LS-71000A, Section 6.4.4.4.9A)

B. If a smooth surface is required, flush or oval head internal hex grip fasteners shall be used for fastening. (LS-71000A, Section 6.4.4.4.9B)

C. Slotted fasteners shall not be used to carry launch loads for hard-mounted equipment. Slotted fasteners are allowed in non-structural applications (e.g., computer data connectors, stowed commercial equipment). (LS-71000A, Section 6.4.4.4.9C)

3.3.6.41 One-Handed Actuation

Fasteners planned to be removed or installed on-orbit shall be designed and placed so they can be mated/demated using either hand. (LS-71000A, Section 6.4.4.4.10)

3.3.6.42 DELETED

3.3.6.43 Access Holes

Covers or shields through which mounting fasteners must pass for attachment to the basic chassis of the unit shall have holes for passage of the fastener without precise alignment (and hand or necessary tool if either is required to replace). (LS-71000A, Section 6.4.4.4.12)

3.3.6.44 Controls Spacing Design Requirements

All spacing between controls and adjacent obstructions shall meet the minimum requirements as shown in Figure 3.3.6.44-1, Control Spacing Requirements for Ungloved Operation. (LS-71000A, Section 6.4.5.1)

3.3.6.45 Accidental Activation

Requirements for reducing accidental actuation of controls are defined as follows:

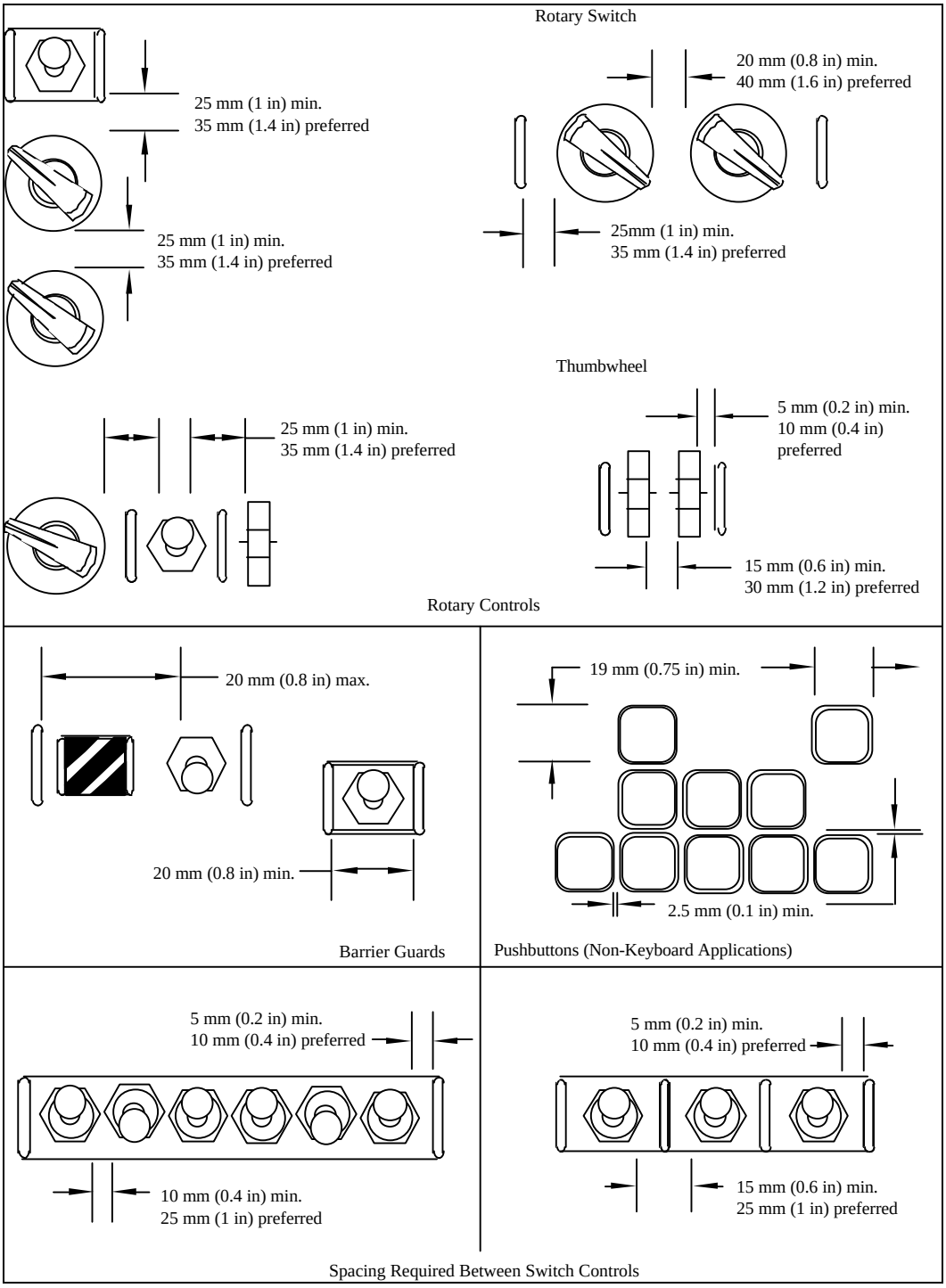


Figure 3.3.6.44-1. Control Spacing Requirements for Ungloved Operation

3.3.6.45.1 Protective Methods

Payloads shall provide protection against accidental control actuation using one or more of the protective methods listed in sub-paragraphs A through G below. Infrequently used controls (i.e., those used for calibration) should be separated from frequently used controls. Leverlock switches or switch covers are strongly recommended for switches related to mission success. Switch guards may not be sufficient to prevent accidental actuation. (LS-71000A, Section 6.4.5.2.1)

NOTE: Displays and controls used only for maintenance and adjustments, which could disrupt normal operations if activated, should be protected during normal operations, e.g., by being located separately or guarded/covered.

A. Locate and orient the controls so that the operator is not likely to strike or move them accidentally in the normal sequence of control movements. (LS-71000A, Section 6.4.5.2.1A)

B. Recess, shield, or otherwise surround the controls by physical barriers. The control shall be entirely contained within the envelope described by the recess or barrier. (LS-71000A, Section 6.4.5.2.1B)

C. Not applicable to MIDAS.

D. Not applicable to MIDAS.

E. Provide the controls with interlocks so that extra movement (e.g., lifting switch out of a locked detent position) or the prior operation of a related or locking control is required. (LS-71000A, Section 6.4.5.2.1E)

F. Provide the controls with resistance (i.e., viscous or coulomb friction, spring-loading, or inertia) so that definite or sustained effort is required for actuation. (LS-71000A, Section 6.4.5.2.1F)

G. Provide the controls with a lock to prevent the control from passing through a position without delay when strict sequential actuation is necessary (i.e., the control moved only to the next position, then delayed). (LS-71000A, Section 6.4.5.2.1G)

3.3.6.45.2 Noninterference

Payload provided protective devices shall not cover or obscure other displays or controls. (LS-71000A, Section 6.4.5.2.2)

3.3.6.45.3 Dead-Man Controls

Not applicable to MIDAS.

3.3.6.45.4 Barrier Guards

Barrier guard spacing shall adhere to the requirements for use with the toggle switches, rotary switches, and thumbwheels as shown in Figures 3.3.6.44-1, Control Spacing Requirements for Ungloved Operation and 3.3.6.45.4-1, Rotary Switch Guard. (LS-71000A, Section 6.4.5.2.4)

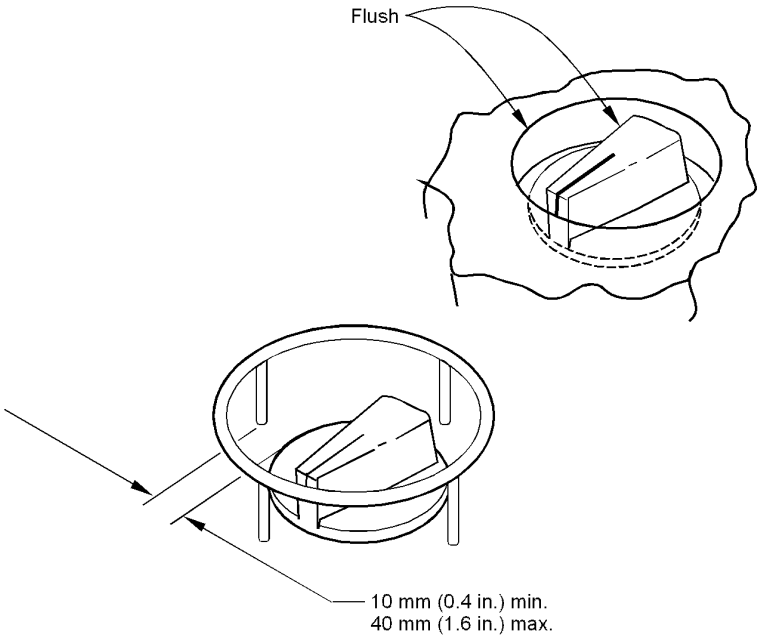


Figure 3.3.6.45.4-1. Rotary Switch Guard

3.3.6.45.5 Recessed Switch Protection

Not applicable to MIDAS.

3.3.6.46 Position Indication

Not applicable to MIDAS.

3.3.6.47 Hidden Controls

Not applicable to MIDAS.

3.3.6.48 Hand Controllers

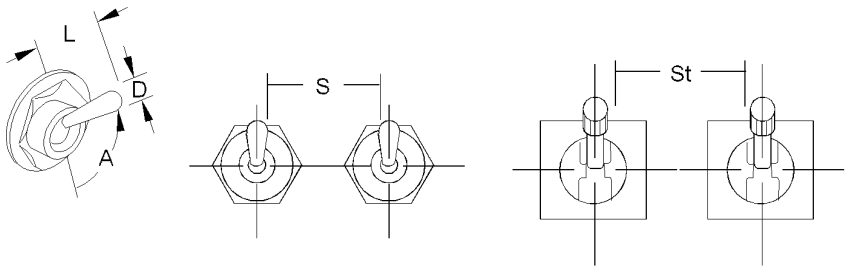
Not applicable to MIDAS.

3.3.6.49 Valve Controls

Not applicable to MIDAS.

3.3.6.50 Toggle Switches

Dimensions for a standard toggle switch shall conform to the values presented in Figure 3.3.6.50-1, Toggle Switches. (LS-71000A, Section 6.4.5.4)



	Dimensions		Resistance	
	L Arm Length	D Control Tip	Small Switch	Large Switch
Minimum	13 mm (1/2 in.)	3 mm (1/8 in.)	2.8 N (10 oz)	2.8 N (10 oz.)
Maximum	50 mm (2 in.)	25 mm (1 in.)	4.5 N (16 oz.)	11 N (40 oz.)

	Displacement between positions	
	A	
	2 position	3 position
Minimum	30°	17°
Maximum	80°	40°
Desired		25°

	Separation			
	Single finger operation	†	S Single finger sequential operation	Simultaneous operation by different fingers
Minimum	19 mm (3/4 in.)	25 mm (1 in.)	13 mm (1/2 in.)	16 mm (5/8 in.)
Optimum	50 mm (2 in.)	50 mm (2 in.)	25 mm (1 in.)	19 mm (3/4 in.)

† Using a lever lock toggle switch

Figure 3.3.6.50-1. Toggle Switches

3.3.6.51 Restraints and Mobility Aids

Payloads shall be designed such that all installation, operation and maintenance can be performed using standard crew restraints, mobility aids and interfaces as defined in SSP 30257:004. (LS-71000A, Section 6.4.6)

3.3.6.51.1 Stowage Drawer Contents Restraints

A. Payload drawer/tray contents shall be restrained in such a way that the items do not float when the drawer/tray is opened or closed. (LS-71000, Section 6.4.6.1A)

B. Payload drawer/tray contents shall be restrained in a way such that the items do not jam the drawer when the drawer is opened or closed. (LS-71000, Section 6.4.6.1B)

C. Drawer/tray contents shall be restrained in such a way that the contents can be removed/replaced without using a tool. (LS-71000, Section 6.4.6.1C)

3.3.6.51.2 Stowage and Equipment Drawers/Trays

A. All latches, handles, and operating mechanisms shall be designed to be latched/unlatched and opened/closed with one hand by the 95th percentile American male to the 5th percentile female. (LS-71000, Section 6.4.6.2A)

B. The design of latches shall be such that their status (locked/unlocked) can be determined through visual inspection. (LS-71000, Section 6.4.6.2B)

3.3.6.51.3 Captive Parts

Payloads and payload equipment shall be designed in such a manner to ensure that all unrestrained parts (e.g., locking pins, knobs, handles, lens covers, access plates, or similar devices) that may be temporarily removed on orbit will be tethered or otherwise held captive. (LS-71000A, Section 6.4.6.3)

3.3.6.51.4 Handle and Grasp Area Design Requirements

Not applicable to MIDAS.

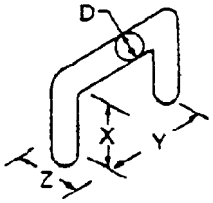
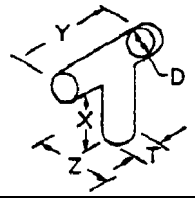
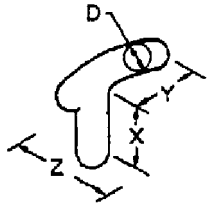
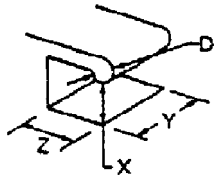
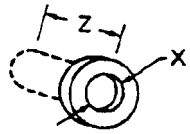
3.3.6.52 Electrical Hazards

Electrical equipment other than bioinstrumentation equipment will incorporate the following controls as specified below:

A. If the exposure condition is below the threshold for shock (i.e., below maximum leakage current and voltage requirements as defined within this

section), no controls are required. Non-patient equipment with internal voltages not exceeding 30 volts rms or DC nominal (32 volts rms or DC maximum) will contain potentials below the threshold for electrical shock. (LS-71000A, Section 6.4.9.1A)

B. If the exposure condition exceeds the threshold for shock, but is below the threshold of the let-go current profile (critical hazard) as defined in Table 3.3.6.52-1, two independent controls (e.g., a safety (green) wire, bonding, insulation, leakage current levels below maximum requirements) shall be provided such that no single failure, event, or environment can eliminate more than one control. (LS-71000A, Section 6.4.9.1B)

Illustration	Type of handle	Dimensions in mm (in inches) (Bare hand)		
		X	Y	Z
	Two-finger bar One-hand bar Two-hand bar	32 (1-1/4) 48 (1-7/8) 48 (1-7/8)	65 (2-1/2) 111 (4-3/8) 215 (8-1/2)	75 (3) 75 (3) 75 (3)
	T-bar	38 (1-1/2)	100 (4)	75 (3)
	J-bar	50 (2)	100 (4)	75 (3)
	Two-finger recess One-hand recess	32 (1-1/4) 50 (2)	65 (2-1/2) 110 (4-1/4)	75 (3) 90 (3-1/2)
	Finger-tip recess On-finger recess	19 (3/4) 32 (1-1/4)	— —	13 (1/2) 50 (2)

Curvature of handle or edge	Weight of item	Minimum Diameter	
(DOES NOT PRECLUDE USE OF OVAL HANDLES)	up to 6.8 kg (up to 15 lbs)	D = 6 mm (1/4 in)	Gripping efficiency is best if finger can curl around handle or edge to any angle of 2/3 *p* rad (120°) or more
	6.8 to 9.0 kg (15 to 20 lbs)	D = 13 mm (1/2 in)	
	9.0 to 18 kg (20 to 40 lbs)	D = 19 mm (3/4 in)	
	Over 18 kg (over 40 lbs)	D = 25 mm (1 in)	
	T-bar post	T = 13 mm (1/2 in)	

Figure 3.3.6.51.4.3-1. Minimum IVA Handle Dimensions for IVA Applications

C. If the exposure condition exceeds both the threshold for shock and the threshold of the let-go current profile (catastrophic hazardous events) as defined in Table 3.3.6.52-1, three independent controls shall be provided such that no combination of two failures, events or environments can eliminate more than two controls. (LS-71000A, Section 6.4.9.1C)

TABLE 3.3.6.52-1. LET-GO CURRENT PROFILE, THRESHOLD VERSUS FREQUENCY

Frequency (Hertz)	Maximum Total Peak Current (AC + DC components combined) milliamperes
DC	40.0
15	8.5
2000	8.5
3000	13.5
4000	15.0
5000	16.5
6000	17.9
7000	19.4
8000	20.9
9000	22.5
10000	24.3
50000	24.3
(Based on 99.5 Percentile Rank of Adults)	

D. If two dependent controls are provided, the physiological effect that a crew member experiences as a result of the combinations of the highest internal voltage applied to or generated within the equipment and the frequency and wave form associated with a worst case credible failure shall be below the threshold of the let-go current profile as defined in Table 3.3.6.52-1. (LS-71000A, Section 6.4.9.1D)

E. If it cannot be demonstrated that the hazard meets the conditions of Paragraph A, B or C above, three independent hazard controls shall be provided such that no combination of two failures, events or environments can eliminate more than two controls. (LS-71000A, Section 6.4.9.1E)

3.3.6.52.1 Mismatched

A. The design of electrical connectors shall make it impossible to inadvertently reverse a connection or mate the wrong connectors if a hazardous condition can be created. (LS-71000A, Section 6.4.9.1.1A)

B. Payload and on-orbit support equipment, wire harnesses, and connectors shall be designed such that no blind connections or disconnections must be made during payload installation, operation, removal, or maintenance on orbit unless the design includes scoop proof connectors or other protective features (NSTS 1700.7B, ISS Addendum, Paragraph 221). (LS-71000A, Section 6.4.9.1.1B)

C. For payload equipment, for which mismating or cross-connection may damage ISS-provided equipment, plugs, and receptacles (connectors), shall be selected and applied such that they cannot be mismatched or cross-connected in the intended system as well as adjacent systems. Although identification markings or labels are required, the use of identification alone is not sufficient to preclude mismating. (LS-71000A, Section 6.4.9.1.1C)

D. For all other payload connections, combinations of identification, keying and clocking, and equipment test and checkout procedures shall be employed at the payload's discretion to minimize equipment risk while maximizing on-orbit operability. (LS-71000A, Section 6.4.9.1.1D)

3.3.6.52.2 Overload Protection

3.3.6.52.2.1 Device Accessibility

An overload protective device shall not be accessible without opening a door or cover, except that an operating handle or operating button of a circuit breaker, the cap of an extractor-type fuse holder, and similar parts may project outside the enclosure. (LS-71000A, Section 6.4.9.1.2.1)

3.3.6.52.2.2 Extractor -Type Fuse Holder

The design of the extractor-type fuse holder shall be such that the fuse is extracted when the cap is removed. (LS-71000A, Section 6.4.9.1.2.2)

3.3.6.52.2.3 Overload Protection Location

Overload protection (fuses and circuit breakers) intended to be manually replaced or physically reset on-orbit shall be located where they can be seen and replaced or reset without removing other components. (LS-71000A, Section 6.4.9.1.2.3)

3.3.6.52.2.4 Overload Protection Identification

Each overload protector (fuse or circuit breaker) intended to be manually replaced or physically reset on-orbit shall be readily identified or keyed for its proper value. (LS-71000A, Section 6.4.9.1.2.4)

3.3.6.52.2.5 Automatic Restart Protection

Controls shall be employed that prevent automatic restarting after an overload-initiated shutdown. (LS-71000A, Section 6.4.9.1.2.5)

3.3.6.53 Audio Devices (Displays)

Not applicable to MIDAS.

3.3.6.54 Egress

All payload egress requirements shall be in accordance with NSTS 1700.7B, ISS Addendum, Paragraph 205. (LS-71000A, Section 6.4.9.11)

3.3.7 System Security

Not applicable to MIDAS.

3.3.8 Design Requirements

3.3.8.1 Structural Design Requirements

3.3.8.1.1 On-orbit Loads

A. MIDAS with MARES installed shall provide positive margins of safety for on-orbit loads of 0.2 Gs acting in any direction. **[SSP 57000E, paragraph 3.1.1.3.B]**

B Crew Induced Load Requirements

The **MIDAS** shall provide positive margins of safety when exposed to the crew induced loads defined in Table 3.3.8.1.1-1, Crew-Induced Loads. **[SSP 57000E, paragraph 3.1.1.3.D]**

TABLE 3.3.8.1.1-1. CREW-INDUCED LOADS

Crew System or Structure	Type of Load	Load	Direction of Load
Levers, Handles, Operating Wheels, Controls	Push or Pull concentrated on most extreme edge	222.6 N (50 lbf), limit	Any direction
Small Knobs	Twist (torsion)	14.9 N-m (11 ft-lbf), limit	Either direction
Exposed Utility Lines (Gas, Fluid, and Vacuum)	Push or Pull	222.6 N (50 lbf)	Any direction
Rack front panels and any other normally exposed equipment	Load distributed over a 4 inch by 4 inch area	556.4 N (125 lbf), limit	Any direction
Legend: ft = feet, m = meter, N = Newton, lbf = pounds force			

3.3.8.1.2 Safety Critical Structures Requirements

The **MIDAS** shall be designed in accordance with the requirements specified in SSP 52005. **[SSP 57000E, paragraph 3.1.1.5.A]**

3.3.8.1.3 Modal Frequency

The MIDAS shall have a modal frequency in accordance with SSP 52005 paragraph 5.7, second paragraph for launch and landing, based on rigidly mounting the MIDAS in the launch configuration. **[SSP 57000E, paragraph 3.1.1.4.C]**

3.3.8.1.4 Launch and Landing Loads

A. MIDAS shall provide positive margins of safety for launch and landing loading conditions in the MPLM based upon an acceleration environment as defined in SSP 41017 Part 1, paragraph 3.2.1.4.2. **[SSP 57000E, paragraph 3.1.1.3.A]**

B. MIDAS interfaces to the MPLM shall be capable of operation during and after exposure to the random vibration environment defined in Table 3.3.8.1.4–1. **[SSP57000E, paragraph 3.1.1.3E]**

TABLE 3.3.8.1.4–1 MPLM RANDOM VIBRATION ENVIRONMENT

Frequency	Level
20 Hz	0.002 g^2/Hz
20-70 Hz	+4.8 dB/oct.
70-150 Hz	0.015 g^2/Hz

150-2000 Hz 2000 Hz	-3.7 dB/oct. 0.0006 g^2/Hz
Composite	2.4 grms

NOTE: Criteria is the same for all directions (X, Y, Z)

C. Components mounted to MIDAS shall maintain positive margins of safety for the launch and landing conditions in the MPLM. For early design, the acceleration environment defined in Table 3.3.8.1.4-2 will be used. These load factors will be superseded by load factors obtained through ISS-performed Coupled Loads Analysis as described in SSP 52005. [SSP57000E, paragraph 3.1.1.3F]

TABLE 3.3.8.1.4-2. PAYLOAD ISPR MOUNTED EQUIPMENT LOAD FACTORS(EQUIPMENT FREQUENCY 35 HZ)

Liftoff	**X**	**Y**	**Z**
(g)	±7.7	±11.6	±9.9
Landing	**X**	**Y**	**Z**
(g)	±5.4	±7.7	±8.8

NOTE: Load factors apply concurrently in all possible combinations for each event and are shown in the rack coordinate system defined in SSP 41017, Part 2, Paragraph 3.1.3.

3.3.8.2 Electrical Power Consuming Equipment Design

Not applicable to MIDAS.

3.4 ACCEPTANCE AND QUALIFICATION REQUIREMENTS

3.4.1 Thermal Environment Compatibility

A. **MIDAS** shall operate nominally during exposure to 16 °C to 30 C (61 °F to 86 °F).

B. **MIDAS** shall operate nominally following exposure to 10 °C to 46 °C (50 °F to 115 °F).

3.4.2 Vibration and Sine Sweep

MIDAS hardware shall meet the vibration and sine sweep requirements as described in 4.3.2.

3.4.3 Functional Acceptance

MIDAS shall operate nominally under all planned modes of operation.

(LS-71000A, Section 5.4.1.3.4)

3.4.4 Electrical, Electronic and Electromechanical Parts Control, Selection and Burn-In

A. Parts control shall be in accordance with SSP 30312, "Electrical, Electronic, and Electromechanical (EEE) and Mechanical Parts Management and Implementation Plan for Space Station Program."

B. Parts selection for equipment shall be in accordance with:

1. SSP-30423, "Space Station Approved Electrical, Electronic and Electromechanical (EEE) Parts List."

2. SSP-30512C, "Space Station Ionizing Radiation Design Environment."

Where no alternative is available, nonmilitary parts, components and subassemblies may be used, but burn-in screening of these items shall be performed per 3.4.4C.

C. Burn-in screening shall be completed (100%) on all flight hardware (units).

3.4.5 Flammability

All **MIDAS** hardware shall meet the flammability test requirements as described in 4.3.5.

3.4.6 Offgassing

All **MIDAS** hardware located in inhabitable areas shall meet the offgassing test requirements as described in 4.3.6.

3.4.7 Shock

All **MIDAS** hardware shall meet the shock test requirements as described in 4.3.7.

3.4.8 Bench Handling

Not applicable to MIDAS.

3.4.9 Payload Mass

All **MIDAS** hardware shall meet the payload mass control requirements as described in 4.3.9.

3.4.10 Electromagnetic Compatibility

All **MIDAS hardware** shall meet the EMC control requirements as described in

4.3.10.

3.4.11 Acoustic Noise

Not applicable to MIDAS.

3.4.12 Safety Critical Structure Verification

3.4.12.1 Safety Critical Structure Dimensional Check

Dimensions for all **MIDAS** elements identified as safety critical structures shall comply with design dimensions.

3.4.12.2 Safety Critical Structure Material Certification

Material composition for all **MIDAS** flight unit elements that are identified as safety critical structures shall be fabricated from the design materials and alloys, and shall be fabricated from materials approved by NASA-JSC.

3.4.13 Software Acceptance

Not applicable to MIDAS.

3.4.14 Pre-Delivery Acceptance

All **MIDAS** equipment shall meet the pre-delivery acceptance requirements as described in 4.3.14. (LS-71000A, Section 5.4.1.3.2)

3.4.15 Pre-Installation Acceptance

The **MIDAS** shall meet the pre-installation acceptance requirements as described in 4.3.15. (LS-71000A, Section 5.4.1.3.3)

3.5 HRP PROGRAM REQUIREMENTS

3.5.1 Safety

The **MIDAS** shall meet the applicable requirements of NSTS 1700.7, NSTS 1700.7 ISS Addendum, NSTS/ISS 18798, NSTS/ISS 13830, and KHB 1700.7.

3.5.2 Documentation Requirements

Documentation requirements for **MIDAS** shall be as specified in Appendix A of the PRD for HRF, LS-71000. Required items for submittal to NASA are summarized below for convenience.

3.5.2.1 Acceptance Data Package (ADP)

The contents of the ADP shall be based upon SSP 30695, Acceptance Data Package Requirements Specification but shall also include the following:

#	Document	Required for Project		Comments
		Yes	No	
1	Engineering Drawings	X		
2	Inventory of Serialized Components	X		
3	Operating, Maintenance, and Handling Procedures	X		
4	"As run" Test Procedures, Data, and Reports	X		
5	Safety Data	X		
6	Structural Analyses	X		
7	Radioactive Material Data		X	No radioactive material.
8	Calibration Data		X	No calibration data.

1. Engineering Drawings: As-built engineering drawings shall be provided. The drawings shall include the top assembly drawing for each major component and any other drawings necessary to perform receiving inspection and any test or operation to be performed at the destination.

2. Inventory of Serialized Components: A list of "field replaceable" serialized components will be included in the ADP. The list will contain the component part number, component name and component serial number.

3. Operating, Maintenance, and Handling Procedures: Each delivered functional end item shall have a separate manual covering its maintenance, repair, and operation. The manual shall include, but not be limited to, the following (as applicable):

    a. Operational instructions suitable to support operator training and containing a system description and general instructions for operating the equipment.

    b. Any special handling, packing, transportation or storage procedures (i.e., must be stored/transported in a specific orientation, specific environmental conditions, etc.)

    c. A list of special tools, support and facilities equipment and all other materials necessary to perform maintenance.

    d. A schedule chart listing the time at which all maintenance is to be performed. This shall also include inspection for required repair, maintenance, or replacement of parts.

    e. Conditions of environment in which maintenance is to be performed.

f. Detailed maintenance procedures that describe removal, disassembly, type of maintenance or repair, cleaning, reassemble and reinstallation of all parts or subassemblies. Also included shall be points of inspection and notes of caution.

g. Illustrated part breakdowns showing the details of the part being worked on.

h. Schematic and interconnecting wiring diagrams in sufficient detail to enable troubleshooting to be performed down to the replaceable subassembly or printed circuit board level.

i. Fault analysis will be provided to facilitate maintenance. The repair procedures shall be adequate for testing, checkout, disassembly, cleaning, inspection, repair, reassembly, adjustment, calibration and servicing of the equipment as applicable.

4. "As Run" Test Procedures and Reports: The original "as run" test procedures used for any of the testing required in this HRD, along with any associated data and test reports shall be included in the ADP. These procedures shall include quality approval, if applicable, as documented in the Quality Plan.

5. Safety Data: Copies of hazard reports and other safety data prepared or collected as a result of ground and/or flight safety requirements.

6. Structural Analyses: Copies of any structural analyses performed as specified in this HRD or required in the contract with NASA.

7. Radioactive Material Data: If the shipment contains any radioactive material, this section shall include copies of all required data on radioactive material.

8. Calibration Data: This section shall include any calibration or scaling data required to interpret the output signals from or measurements made using the equipment being shipped.

3.5.2.1.1 ADP Statement in SOW

The SOW for procured flight items shall contain a DRD specifying the above ADP contents.

4.0 VERIFICATION PROVISIONS

This section contains the required verification methods for ISS interface certification, science functional acceptance and program qualification and acceptance. Section 4.1 addresses definitions for terms used herein.

Appendix B contains the applicability matrix for ISS Pressurized Payload Interface Requirements Document requirements. The Verification Data Sheet addressing the appropriate method for ISS interface verification is also contained in Appendix B. If an alternate verification method is desired, the new verification method must be negotiated in the Unique Payload Verification Plan.

Section 4.2 contains the verification methods for science functional acceptance. Appendix C contains the applicability matrix for science functional requirements.

Section 4.3 contains the verification methods for program qualification and acceptance requirements. Appendix D contains the applicability matrices for acceptance and qualification requirements.

The responsibility for the performance of all verification activities is as specified in Appendices B, C and D. All testing described in Appendices B, C and D shall be documented via TPS (JSC Form 1225) per JSC Work Instruction NT1-CWI-001. Except as otherwise specified in the contract, providers may use their own or any other facility suitable for the performance of the verification requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the verifications set forth in this specification.

4.1 GENERAL

Equipment verification methods are defined as follows:

A. Inspection is a method that determines conformance to requirements by the review of drawings, data or by visual examination of the item using standard quality control methods, without the use of special laboratory procedures.

B. Analysis is a process used in lieu of, or in addition to, other methods to ensure compliance to specification requirements. The selected techniques may include, but not be limited to, engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analysis may also include assessing the results of lower level qualification activity. Analysis may be used when it can be determined that (1) rigorous and accurate analysis is possible, (2) test is not cost effective, and (3) verification by inspection is not adequate.

   Verification by similarity is the process of analyzing the specification criteria for hardware configuration and application for an article to determine if it is similar or identical in design, manufacturing process, and quality control to an existing article that has previously been qualified to equivalent or more

stringent specification criteria. Special effort will be made to avoid duplication of previous tests from this or similar programs. If the previous application is considered to be similar, but not equal to or greater in severity, additional qualification tests shall concentrate on the areas of new or increased requirements.

C. Demonstration consists of a qualitative determination of the properties of a test article. This qualitative determination is made through observation, with or without special test equipment or instrumentation, which verifies characteristics such as human engineering features, services, access features, and transportability. Demonstration requirements are normally implemented within a test plan, operations plan, or test procedure.

D. Test is a method in which technical means, such as the use of special equipment, instrumentation, simulation techniques, and the application of established principles and procedures, are used for the evaluation of components, subsystems, and systems to determine compliance with requirements. Test shall be selected as the primary method when analytical techniques do not produce adequate results; failure modes exist which could compromise personnel safety, adversely affect flight systems or payload operation, or result in a loss of mission objectives; or for any components directly associated with Space Station and orbiter interfaces. The analysis of data derived from tests is an integral part of the test program, and should not be confused with analysis as defined above.

4.2 FUNCTIONAL PERFORMANCE ACCEPTANCE TESTING

The requirements herein describe specific test requirements for functional performance acceptance. *{Document specific test requirements concerning functional performance specifications in subparagraphs to Section 4.2.}*

4.3 ACCEPTANCE AND QUALIFICATION VERIFICATION METHODS

The requirements herein describe specific test requirements for **MIDAS** acceptance and qualification. Qualification testing shall only be performed if qualification articles exist for the hardware. If no qualification articles exist for the hardware, analysis may be used to qualify the hardware.

4.3.1 Thermal Cycle Tests

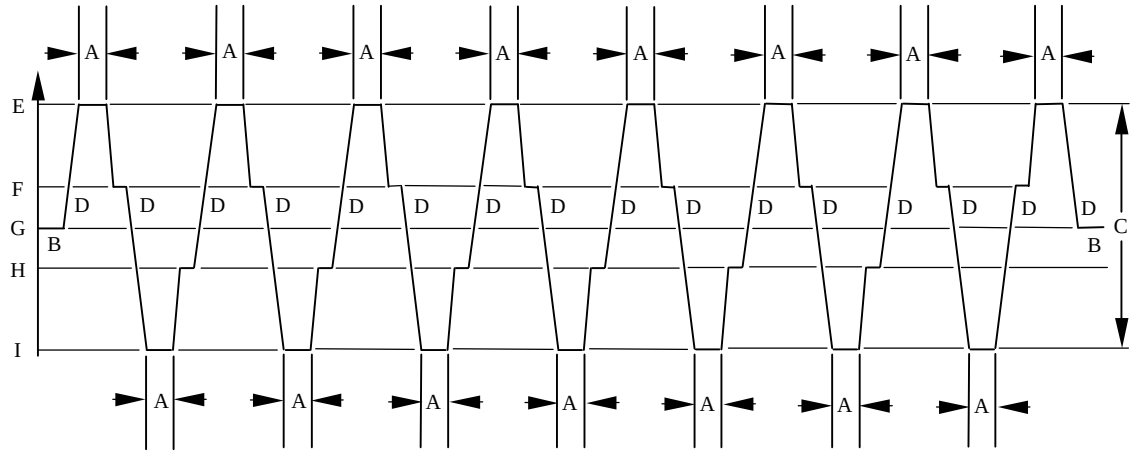
HRF payloads undergoing thermal cycle testing shall be functionally tested at each stable temperature and during transitions. The pass-fail criteria for the functional test and the definition of the functional test will be equipment unique and shall be defined in the test plan and test procedure. Functional tests shall be conducted on end items prior to, during, and after environmental exposure. (LS-71000A, Section 5.4.1.1.6)

4.3.1.1 Qualification Thermal Cycle Test

The Qualification Thermal Cycle Test (QTT) shall be conducted over a temperature range of 61.1 °C (110 °F) centered around the midpoint of the normal operating temperature as defined in Section 3.4.1.A. The Qualification thermal test shall consist of 7½ cycles. One cycle is defined as starting from normal operating temperature, increasing to the maximum high temperature, decreasing to the minimum low temperature and then returning to the normal operating temperature as depicted in Figure 4.3.1.1-1. The complete test is seven and one-half (7½) cycles with one-hour soaks at each extreme. The hardware will be functionally tested during transitions and at the highest and lowest temperature extremes, consistent with the defined operating temperature range. The hardware shall not be functionally tested at temperatures in excess of the defined operating temperature range. (Hardware shall be unpowered when outside the manufacturer's operating limits.) The specific profile shall be defined in the individual test plans. (LS-71000A, Section 5.4.1.1.6.1)

4.3.1.2 Acceptance Thermal Cycle Test

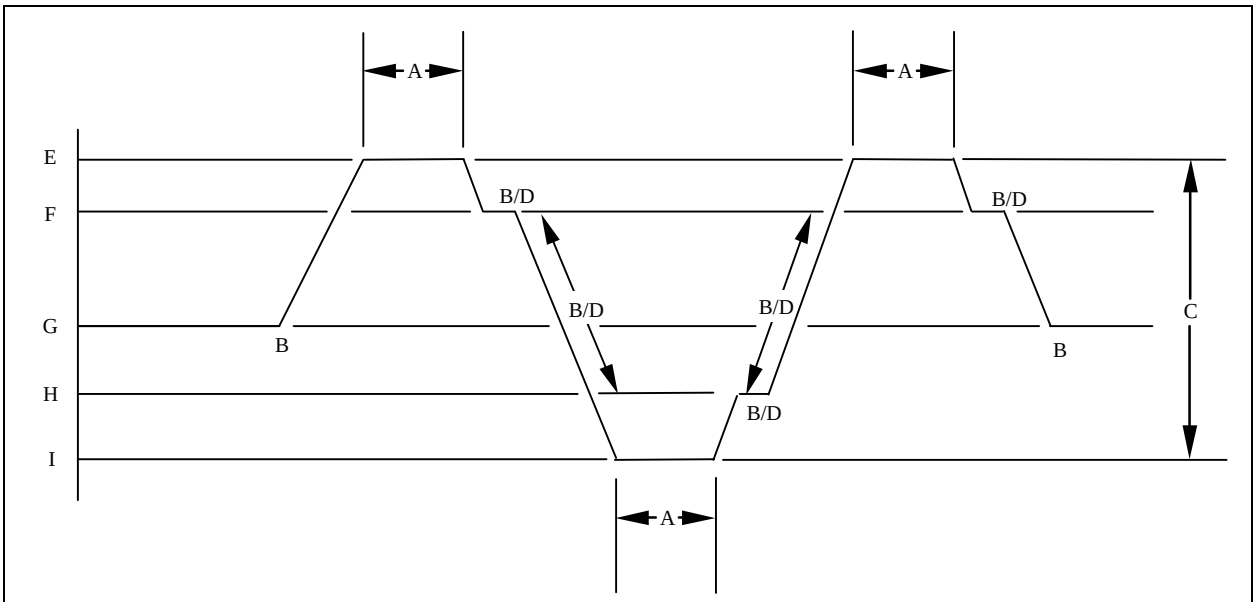
An acceptance Thermal Test (ATT) shall be performed on all flight and flight alternate hardware. The acceptance thermal cycle shall be conducted over a temperature range of 55.6 °C (100 °F) centered around the midpoint of the normal operating temperature as defined in Section 3.4.1.A. The hardware shall be functionally tested before and after the temperature test, at each transition, and at each stable temperature. The hardware shall not be functionally tested at temperatures in excess of the defined operating temperature range. (Hardware shall be unpowered when outside the manufacturer's operating limits.) One cycle is defined as starting from normal operating temperature, increasing to the maximum high temperature, decreasing to the minimum low temperature and then returning to the normal operating temperature as depicted in Figure 4.3.1.2-1. The complete test consists of one and one-half (1½) thermal cycles with one-hour soaks at each extreme. Minimum temperature sweep shall be 100 °F around the normal operating temperature, and the hardware shall dwell at the temperature extremes for a minimum of 1 hour**.** (LS-71000A, Section 5.4.1.1.6.2)



NOTES:

1. A = Time to stabilize equipment temperature plus 1-hour minimum.
2. B = Functional tests to be performed as shown.
3. C = Control temperature range between high and low acceptance test conditions shall be a minimum of 61.11 °C (110 °F). Contractor is to specify tolerances on stable temperature periods.
4. D = Simplified Functional Test. Rate of temperature change during temperature transition shall not be less than 0.55 °C (1 °F)/min. nor greater than 2.22 °C (4 °F) (4 °F)/min.
5. E = Median operational temperature plus 30.56 °C (55 °F).
6. F = Maximum operational temperature.
7. G = Median operational temperature.
8. H = Minimum operational temperature.
9. I = Median operational temperature minus 30.56 °C (55 °F).

Figure 4.3.1.1-1. Qualification Thermal Cycling



NOTES:

1. A = Time to stabilize equipment temperature plus 1-hour minimum.
2. B = Functional tests to be performed as shown.
3. C = Control temperature range between high and low acceptance test conditions shall be a minimum of 55.56 °C (100 °F). Contractor is to specify tolerances on stable temperature periods.
4. D = Simplified Functional Test. Rate of temperature change during temperature transition shall not be less than 0.55 °C (1 °F)/min. nor greater than 2.22 °C (4 °F) (4 °F)/min.
5. E = Median operational temperature plus 27.78 °C (50 °F).
6. F = Maximum operational temperature.
7. G = Median operational temperature.
8. H = Minimum operational temperature.
9. I = Median operational temperature minus 27.78 °C (50 °F).

Figure 4.3.1.2-1. Acceptance Thermal Cycling

4.3.2 Vibration Tests

An analysis shall be conducted which uses the referenced acceleration data and determines integrated rack structure loads via Finite Element Modeling (FEM). The analysis shall be considered successful when the FEM is approved by the ISS Program and the model determines integrated rack structure loads that maintain positive margins of safety, based upon the rack structure allowables identified in section 3.3.8.1.4

4.3.3 Functional Testing

The scope and method of functional testing shall be negotiated between the hardware developer and the quality organization responsible for accepting the hardware. (LS-71000A, Section 5.4.1.3.4)

4.3.4 Electrical, Electronic, and Electromechanical Parts Control, Selection, and Burn-In

A Compliance with 3.4.4.A is considered successful when it can be shown via analysis that the parts control process is compliant with 3.4.4.A. (LS-71000A, Section 5.4.1.1.10)

B. Compliance with 3.4.4.B is considered successful when an analysis is provided which includes a risk assessment, electrical stress analysis, and data delivery on information such as designed/as-built EEE parts, list, construction history, Government and Industry Data Exchange Program (GIDEP) Alerts, part obsolescence, radiation susceptibility, and/or prior history. (LS-71000A, Section 5.4.1.1.10)

C. The burn-in test may be accomplished at the component or assembly level, and is specified as:

- 72 hrs continuously at room ambient temperature while functioning
- 96 hrs continuously at a specified controlled temperature while functioning.

Full functional tests shall be performed on the experiment hardware before and after the burn-in test. Controlled temperature is defined as 15 °C below the maximum rating of the device with the lowest temperature rating in the article under test. (LS-71000A, Section 5.4.1.1.10)

All flight assemblies utilizing non-military parts (as specified in Section 3.4.4) shall undergo burn-in testing. (LS-71000A, Section 5.4.1.1.10)

4.3.5 Flammability

Payload materials shall be non-flammable or self-extinguishing per the test criteria of NASA-STD-6001, Test 1, Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion. The material shall be evaluated in the worst-case use environment at the worst-case use configuration. When the use of a nonflammable material is not possible, a Material Usage Agreement (MUA) or equivalent shall be submitted to the cognizant NASA center for disposition. If test data does not exist for a material, the experimenter may be asked to provide samples (see NASA-STD-6001, Chapter 4) to a NASA certified test facility Marshall Space Flight Center (MSFC) or White Sands Test Facility (WSTF) for flammability testing). (LS-71000A, Section 5.4.1.1.8)

Materials transported or operated in the orbiter cabin, or operated in the ISS air lock during Extravehicular Activity (EVA) preparations, shall be tested and evaluated for flammability in the worst-case use environment of 30% oxygen and 10.2 psia. Materials used in all other habitable areas shall be tested and evaluated in the worst-case use environment of 24.1% oxygen and 15.2 psia. (LS-71000A, Section 5.4.1.1.8)

4.3.6 Offgassing

All flight hardware located in habitable areas shall be subjected to test and meet the toxicity offgassing acceptance requirements of NASA-STD-6001, Test 7. (LS-71000A, Section 5.4.1.1.9)

4.3.7 Shock Test

Not applicable to MIDAS.

4.3.8 Bench Handling

Not applicable for MIDAS.

4.3.9 Payload Mass

The MIDAS weight requirement shall be verified by a demonstration involving measuring the weight of the MIDAS on the ground prior to launch and an analysis that accounts for attached GSE and any changes during on-orbit operations prior to return of the payload. Verification shall be considered successful when the weight is measured to an accuracy of 2.3 kg (5 lbs) and is less than the specified maximum weight. (SSP 57000E, Section 4.3.1.1.4A)

4.3.10 Electromagnetic Compatibility

The **MIDAS** shall comply with LS-71016A, HRF EMI/EMC Control Plan. (LS-71000A, Section 5.4.1.2.1)

4.3.11 Acoustic Noise

Not applicable to MIDAS.

4.3.12 Safety Critical Structure Verification

4.3.12.1 Safety Critical Structure Dimensional Check

All **MIDAS** elements identified as safety critical structures shall be verified to be in accordance with the final design drawing dimensional requirements. (LS-71000A, Section 5.4.1.1.11.1)

4.3.12.2 Safety Critical Structure Material Certification

All MIDAS elements that are identified as safety critical structures shall have the components used in those safety-critical structures certified to be fabricated from the materials and alloys identified in the final design drawing, and to be fabricated from materials approved by NASA-JSC. (LS-71000A, Section 5.4.1.1.11.2)

4.3.13 Software Acceptance

Not applicable to MIDAS.

4.3.14 Pre-Delivery Acceptance

The responsible manufacturing parties shall perform a Pre-Delivery Acceptance (PDA) after the complete fabrication and assembly has been conducted for all Class I deliverable assemblies. This test shall include verification of software interface and operation. The PDA must be completed before hardware certification testing begins. It is a full functional test and inspection that validates that the hardware operates per the design requirements and that it is constructed

per released engineering drawings. All PDA tests shall be approved by the hardware's JSC technical monitor and JSC/NT3, as well as the contractor quality engineering (if applicable). The following are standard steps that each PDA test shall contain:

1. Conformance to Drawing. Verify that the hardware conforms to released engineering drawings.

2. No Sharp Edges. Inspect the hardware to verify that there are no sharp edges or corners present.

3. Proper Identifying Markings. Verify that the hardware has the proper part number and serial number (if applicable) on it.

4. Weight and Center of Gravity. Measurements shall be taken of the as-built configuration per Section 3.2.2.1 of this document.

5. Functional Testing. This is a full functional test and checks all interfaces.

(LS-71000A, Section 5.4.1.3.2)

4.3.15 Pre-Installation Acceptance (PIA)

PIA testing occurs prior to installation in the MPLM.

1. Cleanliness. PIA tests shall include verification that surfaces are to the cleanliness level of Section 3.3.1.1.4 of this document.

2. Functional Testing. PIA functional testing checks rack interfaces prior to installation in the MPLM.

(LS-71000A, Section 5.4.1.3.3)

5.0 PREPARATION FOR SHIPMENT

5.1 General

A. The methods of preservation, packaging, and packing used for shipment, together with necessary special control during transportation, shall adequately protect the article(s) from damage or degradation in reliability or performance as a result of the natural and induced environments encountered during transportation and subsequent indoor storage. (LS-71000A, Section 9.1A)

B. To reduce program cost, prior to developing a newly designed container, every effort will be made by project participants to use container designs and/or containers available commercially or from Government inventories. If reusable containers are not available, a screening process should be initiated for container availability in the following priority: existing containers, commercial off-the-shelf containers and modified commercial off-the shelf containers. Shipping containers and protective devices will be designed for effective and economical manufacture, procurement and transportability. (LS-71000A, Section 9.1B)

5.2 Packing, Handling and Transportation

A. Packaging, handling and transportation shall be in accordance with applicable requirements of NHB 6000.1C and referenced documents therein. (LS-71000A, Section 9.2A)

B. Documented procedures and physical controls shall be established to ensure that the MIDAS and individual items of equipment will not be subjected to temperature, shock and humidity outside the non-operational limits during shipment. (LS-71000A, Section 9.2C)

C. The **MIDAS** shall be cleaned to the "Visibly Clean Level 1 (Sensitive)" as determined in SN-C-0005, Specification Contamination Control Requirements for the Shuttle Program. (LS-71000A, Section 9.2D)

5.3 Preservation and Packing

Preservation and packing shall be in accordance with approved Packaging, Handling and Transportation Records (PHTRs). (LS-71000A, Section 9.3)

5.4 Marking for Shipment

Interior and exterior containers shall be marked and labeled in accordance with NHB 6000.1C including precautionary markings necessary to ensure safety of personnel and facilities, and to ensure safe handling, transport, and storage. Should the individual items of equipment contain any hazardous materials, markings shall also comply with applicable requirements governing packaging and

labeling of hazard materials. Packages with reuse capability shall be identified with the words “Reusable Container - Do Not Destroy - Retain for Reuse.” NASA Critical Item Labels (Form 1368 series) shall be applied in accordance with NHB 6000.1C. (LS-71000A, Section 9.4)

5.5 NASA Critical Space Item Label

The NASA Critical Space Item Labels Form 1368 shall be affixed to exterior and interior shipping containers in accordance with NHB 6000.1C. (LS-71000A, Section 9.5A)

6.0 NOTES

This section contains information of a general or explanatory nature that may be helpful but is not mandatory.

6.1 Definitions

Qualification Test	Test conducted as part of the certification program to demonstrate that the design and performance requirements can be realized under specified conditions.
Acceptance Test	Formal tests conducted to assure that the end item meets specified requirements. Acceptance tests include performance demonstrations and environmental exposures to screen out manufacturing defects, workmanship errors, incipient failures and other performance anomalies not readily detectable by normal inspection techniques or through ambient functional tests.
Active Air Exchange	Forced convection between two volumes. For example, forced convection between a subrack payload and the internal volume of an integrated rack, or forced convection between a subrack payload and cabin air.
Continuous Noise Source	A significant noise source that exists for a cumulative total of eight hours or more in any 24-hour period is considered to be a continuous noise source.
Intermittent Noise Source	A significant noise source that exists for a cumulative total of less than eight hours in a 24-hour period is considered to be an intermittent noise source.
On-Orbit Momentary Protrusions	Payload Obstructions that typically would protrude for a very short time or could be readily eliminated by the crew at any time. Momentary protrusions include only the following: drawer/door/cover replacement or closure.
On-Orbit Permanent Protrusion	A payload hardware item that is not ever intended to be removed.

On–Orbit Protrusions for Keep Alive Payloads	A protrusion that supports and/or provides the uninterrupted resources necessary to run an experiment. On–orbit protrusions for Keep Alive Payloads includes only power/data cables and thermal hoses.
On-Orbit Semi-Permanent Protrusion	A payload hardware item that is typically left in place, but can be removed by the crew with hand operations or standard IVA tools. Example: SIR and ISIS drawer handles, other equipment that does not interfere with crew restraints and mobility aids.
On-Orbit Temporary Protrusion	A payload item that is typically located in the aisle for experiment purposes only. These items should be returned to their stowed configuration when not being used. Example: Front panel mounted equipment.

APPENDIX A

RESERVED

APPENDIX B

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

APPENDIX B

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

{*If a request for deviation or waiver from the requirement stated in this HRD is anticipated or if the type of documentation supplied or method of verification is anticipated to not be as stated in this matrix, this information should be noted in the Comment column.*}

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.2.1		3.1.1.4A	Mass and Center of Gravity Properties	✓			
3.2.2.2.2.1A	--	3.1.1.7A	On-Orbit Payload Protrusions - Lateral Extension	✓	ME-059		
3.2.2.2.2.1B	--	3.1.1.7B	On-Orbit Payload Protrusions - Attachment of RMA	✓	ME-059		
3.2.2.2.2.1.1	--	3.1.1.7.1	On-Orbit Permanent Protrusions	N/A	ME-059		MIDAS has no permanent protrusions
3.2.2.2.2.1.2A	--	3.1.1.7.2A	On-Orbit Semi-Permanent Protrusions - SIR and ISIS Drawer Handles	N/A	ME-059		No handles in MIDAS
3.2.2.2.2.1.2B	--	3.1.1.7.2B	On-Orbit Semi-Permanent Protrusions - Other	✓	ME-059		
3.2.2.2.2.1.2C	--	3.1.1.7.2C	On-Orbit Semi-Permanent Protrusions - Removable	✓	ME-059		
3.2.2.2.2.1.3A	--	3.1.1.7.3A	On-Orbit Temporary Protrusions - Envelope	✓	ME-059		
3.2.2.2.2.1.3B	--	3.1.1.7.3B	On-Orbit Temporary Protrusions - Removal	✓	ME-059		
3.2.2.2.2.1.4	--	3.1.1.7.4	On-Orbit Momentary Protrusions	N/A	ME-059		MIDAS has no momentary protrusions
3.2.4A	6.4.4.2.6.3	3.12.4.2.8.4	Maintainability - Unique Tools	N/A	ME-016		No unique tools to MIDAS
3.2.4B	6.4.4.3.1	3.12.4.3.1	Maintainability - One-handed Operation	✓	ME-017		
3.2.4C	6.4.4.3.2B	3.12.4.3.2A2	Maintainability - Connector Mate/Demate	✓	ME-018		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.4D	6.4.4.3.2C	3.12.4.3.2B	Maintainability - No Damage to Wiring Connectors	✓	ME-018		
3.2.4E	6.4.4.2.6	3.12.4.2.8	Maintainability - Access to Hardware Items	✓	ME-042		
3.2.4F	6.4.3.1.2A	3.12.3.1.2A	Maintainability - Built-in Control	N/A	ME-008		No fluids
3.2.4G	6.4.3.1.2B	3.12.3.1.2B	Maintainability - Access to Filters for Replacement/Cleaning	N/A	ME-008		No capture elements
3.2.4.1.1	6.4.10	3.12.10	Payload In-flight Maintenance	✓	ME-003		
3.2.5.1.1.1	6.1.9.1.1	3.9.1.1	Pressure	✓	Safety		
3.2.5.1.1.2	6.1.9.1.2	3.9.1.2	Temperature	✓	Safety		
3.2.5.1.1.3	6.1.9.1.3	3.9.1.3	Humidity	N/A	EN-001		No cold sources
3.2.5.1.2.1	6.1.9.2.1	3.9.2.1	Active Air Exchange	N/A	EN-002		No active air exchange
3.2.5.1.2.2	6.1.9.2.2	3.9.2.2	Oxygen Consumption	N/A	EN-003		No oxygen consuming equipment
3.2.5.1.2.3	6.1.9.2.3	3.9.2.3	Chemical Releases	✓	Safety		MIDAS has no chemical releases
3.2.5.1.2.4	6.1.5.12	3.5.1.12	Cabin Air Heat Leak	✓	FD-008		
3.2.5.1.3.1	6.2.9.3.1	3.9.3.1	Instrument Contained or Generated Ionizing Radiation	✓	Safety		No radioactive materials or radiation sources
3.2.5.1.3.3	6.1.9.3.3	3.9.3.3	Single Event Effect (SEE) Ionizing Radiation	✓	EN-004		
3.2.5.1.5A	6.1.1.4B	3.1.1.4B	Pressure Rate of Change - On-orbit	✓	ST-003		
3.2.5.1.5B	6.1.1.2B	3.1.1.2B	Pressure Rate of Change - MPLM	✓	ST-003		
3.2.5.1.5C	6.1.1.4H	3.1.1.4K	Pressure Rate of Change - PFE	N/A	ST-003		MIDAS has no PFE port
3.2.5.1.5D		3.1.1.4M	Pressure Relief Device	N/A	TBD		No relief devices
3.2.5.2	6.4.3.3	3.12.3.3	Acoustic Emission Limits	N/A	EN-006		MIDAS contains no noise sources
3.2.5.3A	6.4.3.4A	3.12.3.4A	Lighting Design - Specularity	✓	ME-043		
3.2.5.3B	6.4.3.4B	3.12.3.4B	Lighting Design - Levels	N/A	ME-043		MIDAS will use PUL if necessary
3.2.5.3C	6.4.3.4C	3.12.3.4C	Lighting Design - Dimmable	N/A	ME-043		MIDAS has no light sources.

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.5.3D	6.4.3.4D	3.12.3.4D	Lighting Design - Brightness Ratio	N/A	ME-043		MIDAS has no glovebox
3.2.5.3E	6.4.3.4E	3.12.3.4E	Lighting Design - Utilize ISS PUL	✓	ME-043		
3.2.7.1.1A	6.1.1.1A	3.1.1.1A	GSE Interface – Rack Insertion Device	✓			
3.2.7.1.1B	6.1.1.1B	3.1.1.1B	GSE Interface –Rack Shipping Container	✓			
3.2.7.1.1C	6.1.1.1C	3.1.1.1C	GSE Interface –Rack Handling Adapter	✓			
3.2.7.1.1D	6.1.1.1D	3.1.1.1D	GSE Interface –Acceleration	✓			
3.2.7.1.2.1A	6.1.1.2A	3.1.1.2A	MPLM Interface –Attach Points	✓			
3.2.7.1.2.1B	6.1.1.2C	3.1.1.2E	MPLM Interface –Loads	✓			
3.2.7.1.3A	6.1.1.4E	3.1.1.4E	Keep-out Zone	✓			
3.2.7.1.3B	6.1.1.4F	3.1.1.4I	Rack Rotation	✓			
3.2.7.1.3C	6.1.1.4I	3.1.1.4L	Restraints during Rotation	✓			
3.2.7.1.4.1	6.1.1.6.1	3.1.1.6.1	Connector Physical Mate	✓	EL-007 ME-056		
3.2.7.1.4.2	6.1.1.6.2	3.1.1.6.2	Umbilical Physical Mate	✓			
3.2.7.2.1.1	6.1.2.1	3.2.1.1.1	Steady-State Voltage – Interface B	✓			
3.2.7.2.1.2	6.1.2.1	3.2.1.1.2	Steady-State Voltage – Interface C	✓			
3.2.7.2.2.1	6.1.2.2.1	3.2.1.2.1	Ripple Voltage/Noise Characteristics - Peak to Peak	✓			
3.2.7.2.2.2	6.1.2.2.2	3.2.1.2.2	Ripple Voltage/Noise Characteristics - Spectrum	✓			
3.2.7.2.3.1	6.1.2.3	3.2.1.3.1	Transient Voltages – Interface B	✓			
3.2.7.2.3.2	6.1.2.3	3.2.1.3.2	Transient Voltages – Interface C	✓			
3.2.7.2.4	6.1.2.4	3.2.1.3.3	Fault Clearing and Protection	✓			
3.2.7.2.5A	6.1.2.5A	3.2.1.3.4A	Non-Normal Voltage Range – Overvoltage	✓			
3.2.7.2.5B	6.1.2.5B	3.2.1.3.4B	Non-Normal Voltage Range – Undervoltage	✓			
3.2.7.2.6B	6.1.2.7B	3.2.2.1B	UIP and UOP Connectors and Pin Assignments – UIP Pin-out	✓			

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.7.2.6C	6.1.2.7C	3.2.2.1C	UIP and UOP Connectors and Pin Assignments – UIP Connectors	✓			
3.2.7.2.6E		3.2.2.1E	UIP and UOP Connectors and Pin Assignments - UOP Pin-out	✓			
3.2.7.2.6F		3.2.2.1F	UIP and UOP Connectors and Pin Assignments – UOP Connectors	✓			
3.2.7.2.7A	6.1.2.8A	3.2.2.2A	Power Bus Isolation – Single Failure	✓			
3.2.7.2.7B	6.1.2.8B	3.2.2.2B	Power Bus Isolation – Use of Diodes	✓			
3.2.7.2.8	6.1.2.9	3.2.2.3	Compatibility with Soft Start/Stop RPC	✓			
3.2.7.2.9	6.1.2.10	3.2.2.4	Surge Current	✓			
3.2.7.2.10		3.2.2.5	Reverse Energy/Current	✓			
3.2.7.2.11A		3.2.2.6.1.1A	Remote Power Controllers – Interface B	✓			
3.2.7.2.11B		3.2.2.6.1.1D	Remote Power Controllers – Overcurrent Protection	✓			
3.2.7.2.11C		3.2.2.6.1.1E	Remote Power Controllers – Overcurrent Protection Interface B	✓			
3.2.7.2.11D		3.2.2.6.2.1.1	Remote Power Controllers – Trip Rating	✓			
3.2.7.2.11E		3.2.2.6.1.1C	Remote Power Controllers – UOP	✓			
3.2.7.2.12.1		3.2.2.7.1	Rack Complex Load Impedances – Interface B	✓			
3.2.7.2.12.2		3.2.2.7.2	Rack Complex Load Impedances – Interface C	✓			
3.2.7.2.13		3.2.2.8	Large Signal Stability	✓			
3.2.7.2.15A		3.2.2.10A	Electrical Load-Stand Alone Stability – CS01	✓			
3.2.7.2.15B		3.2.2.10B	Electrical Load-Stand Alone Stability – CS02	✓			
3.2.7.2.15C		3.2.2.10C	Electrical Load-Stand Alone Stability – CS06	✓			
3.2.7.2.16A	6.1.2.17A	3.2.3.1B	Wire Derating - Derating	✓	EL-017		
3.2.7.2.16B	6.1.2.17B	3.2.3.1C	Wire Derating - AWG	✓	EL-017		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.7.2.16C		3.2.3.1A	Wire Derating - UOP	✓	EL-017		
3.2.7.2.17A	6.1.2.18A	3.2.3.2A	Exclusive Power Feeds - UIP	✓	EL-018		
3.2.7.2.17B	6.1.2.18B	3.2.3.2B	Exclusive Power Feeds – Cabling	✓	EL-018		
3.2.7.2.18	6.1.2.19	3.2.3.3	Loss of Power	✓	Safety		
3.2.7.2.19	6.1.2.20	3.2.4	Electromagnetic Compatibility (EMC)	✓	EL-020		
3.2.7.2.19.1	6.1.2.20.1	3.2.4.1	Electrical Grounding	✓	EL-021		
3.2.7.2.19.2	6.1.2.20.2	3.2.4.2	Electrical Bonding	✓	EL-022		
3.2.7.2.19.3	6.1.2.20.3	3.2.4.3	Cable/Wire Design and Control Requirements	✓	EL-021		
3.2.7.2.19.4A	6.1.2.20.4	3.2.4.4	Electromagnetic Interference	✓	EL-020		
3.2.7.2.19.4B	6.1.2.20.4	3.2.4.4	Electromagnetic Interference - Alternative Use of RS03PL	✓	EL-020		
3.2.7.2.19.5	6.1.2.20.5	3.2.4.6	AC Magnetic Fields	✓	EL-020		
3.2.7.2.19.6	6.1.2.20.6	3.2.4.7	DC Magnetic Fields	✓	EL-020		
3.2.7.2.20	6.1.2.21	3.2.4.5	Electrostatic Discharge	✓	EL-024		
3.2.7.2.21	6.1.2.22	3.2.4.8	Corona	✓	EL-024		
3.2.7.2.22	6.1.2.23	3.2.4.9	Lightning	✓	EL-024		
3.2.7.3	6.1.3	3.3	Command and Data Handling Interface	N/A	CD-001		No C&DH interfaces
3.2.7.4	6.1.4	3.4	Payload NTSC Video Interface	N/A			No video interfaces
3.2.7.5	6.1.5	3.5	Thermal Control Interface	N/A			No thermal control interfaces
3.2.7.6	6.1.6	3.6	Vacuum System Interface	N/A			No vacuum interfaces
3.2.7.7	6.1.7	3.7	Pressurized Gas Interface	N/A	FD-028		No pressurized gas interfaces
3.2.7.8	6.1.8	3.8.2	Fluid System Services	N/A	ME-049		No payload support services interfaces
3.2.7.9.1	6.1.10.1	3.10.1	Fire Prevention	✓	Safety		
3.2.7.9.2	6.1.10.2	3.10.2.1-2	Payload Monitoring and Detection Requirements	N/A	Safety		No FDS in MIDAS

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.7.9.3.1A-B	6.1.10.2A-B	3.10.3.1A-B	PFE - Small Access Port	N/A	ME-055		MIDAS has no PFE ports
3.2.7.9.3.2	6.1.10.3.2	3.10.3.2	Fire Suppression Access Port Accessibility	N/A	ME-055		MIDAS has no PFE ports
3.2.7.9.3.3	6.1.10.3.3	3.10.3.3	Fire Suppressant Distribution	N/A	ME-055		MIDAS has no PFE ports
3.2.7.9.4A	6.1.10.4A	3.10.4A	Labeling – PFE Port	N/A	ME-055		MIDAS has no PFE ports or FDS
3.2.7.9.4B	6.1.10.4B	3.10.4B	Labeling – Fire Detection LED	N/A	ME-055		MIDAS has no PFE ports or FDS
3.3.1.1.1	6.1.11.1	3.11.1	Materials and Parts use and Selection	✓	Safety		PSRP Approval
3.3.1.1.2	6.1.11.1.1	3.11.1.1	Commercial Parts	✓	Safety		PSRP Approval
3.3.1.1.3A-C	6.1.11.2A-C	3.11.2A-C	Fluids	N/A	MP-001		No fluids in MIDAS
3.3.1.1.4	6.1.11.3	3.11.3	Cleanliness	✓	MP-002		Inspect drawings, TPS
3.3.1.1.5	6.1.11.4	3.11.4	Fungus Resistant Material	✓	MP-003		Mat'l Cert
3.3.1.2	6.4.9.2	3.12.9.2	Sharp Edges and Corner Protection	✓	Safety		PSRP Approval
3.3.1.3	6.4.9.3	3.12.9.3	Holes	✓	ME-007		No holes in the range of 10-25 mm
3.3.1.4	6.4.9.4	3.12.9.4	Latches	✓	ME-027		No latches in design
3.3.1.5	6.4.9.5	3.12.9.5	Screws and Bolts	✓	ME-026		
3.3.1.6	6.4.9.6	3.12.9.6	Securing Pins	✓	ME-053		
3.3.1.7	6.4.9.7	3.12.9.7	Levers, Cranks, Hooks, and Controls	✓	ME-053		
3.3.1.8	6.4.9.8	3.12.9.8	Burrs	✓	ME-053		
3.3.1.9A-B	6.4.9.9A-B	3.12.9.9A-B	Locking Wires	N/A	ST-009		No locking wires or fracture critical devices
3.3.2.1	6.4.7	3.12.7	Equipment Identification	✓	ME-057		
3.3.5.1	6.1.2.24	3.2.4.10	EMI Susceptibility for Safety-Critical Circuits	N/A	EL-019		No safety-critical circuits
3.3.5.2.1	6.1.2.25.1	3.2.5.1.1	Mating/Demating of Powered Connectors	✓			
3.3.5.2.2	6.1.2.25.2	3.2.5.1.2	Safety-Critical Circuits Redundancy	N/A	Safety		No safety-critical circuits

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.5.2.3	6.1.2.25.3	3.2.5.2.3?	Power Removal Switch	✓	Safety		
3.3.5.2.4A	6.1.2.25.4A	3.2.5.3A	Power Switches/Controls - Open Supply Circuit Conductors	✓	EL-029		
3.3.5.2.4B	6.1.2.25.4B	3.2.5.3B	Power Switches/Controls - Power-off Markings/Indications	✓	EL-029		
3.3.5.2.4C	6.1.2.25.4C	3.2.5.3C	Power Switches/Controls - Supply Circuit not Completely Disconnected	N/A	EL-029		No standby mode
3.3.5.2.5A	6.3.2.10.5B	3.2.5.5A	Portable Equipment/Power Cords – Three-wire power cord	✓	EL-031		
3.3.5.2.5B	6.3.2.10.5B	3.2.5.5B	Portable Equipment/Power Cords – Fault currrent	N/A	EL-031		
3.3.6.1	6.4.3.1.1	3.12.3.1.1	Closures or Covers Design Requirements	N/A	ME-007		MIDAS designed for routine cleaning
3.3.6.2		3.12.8	Color	✓			
3.3.6.3	6.4.2.3	3.12.2.3	Full Size Range Accommodation	✓	ME-006		
3.3.6.4A	6.4.1.1A	3.12.1A1	Grip Strength	✓	ST-005		
3.3.6.4B	6.4.1.1B	3.12.1A2	Linear Forces	✓	ST-005		
3.3.6.4C	6.4.1.1C	3.12.1A3	Torque	✓	ST-005		
3.3.6.5	6.4.1.2	3.12.1B	Maintenance Operations	✓	ST-005		
3.3.6.6	6.4.2.1	3.12.2.1	Adequate Clearance	✓	ME-021		
3.3.6.7A	6.4.2.2A	3.12.2.2A	Accessibility - Geometric Arrangement	✓	ME-021		
3.3.6.7B	6.4.2.2B	3.12.2.2B	Accessibility - Access Openings for Fingers	✓	ME-021		
3.3.6.8	6.4.3.1.3	3.12.3.1.5	One-Handed Operation	N/A	ME-009		No cleaning supplies for MIDAS
3.3.6.9	6.4.3.2.1	3.12.3.2.1	Continuous/Incidental Contact - High Temperature	✓	Safety		
3.3.6.10	6.4.3.2.2	3.12.3.2.2	Continuous/Incidental Contact - Low Temperature	N/A	Safety		MIDAS serves no cooling functions.
3.3.6.11	6.4.4.2.1	3.12.4.2.1	Equipment Mounting	✓	ME-011		
3.3.6.12A-B	6.4.4.2.2A-B	3.12.4.2.2	Drawers and Hinged Panels	✓	ME-012		MIDAS has no ORUs for routine checkout.

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.13	6.4.4.2.3	3.12.4.2.5	Alignment	✓	ME-013		
3.3.6.14	6.4.4.2.4	3.12.4.2.6	Slide-Out Stops	✓	ME-002		
3.3.6.15	6.4.4.2.5	3.12.4.2.7	Push-Pull Force	✓	ST-006		
3.3.6.16A-B	6.4.4.2.6.1A-B	3.12.4.2.8.1A-B	Covers - sliding or hinged cap or door	N/A	ME-007		No physical access required
3.3.6.17	6.4.4.2.6.2	3.12.4.2.8.2	Self-Supporting Covers	N/A	ME-007		No physical access required.
3.3.6.18	6.4.4.3.2A	3.12.4.3.2A1	Accessibility	✓	ME-018		
3.3.6.19A	6.4.4.3.3A	3.12.4.3.3A	Ease of Disconnect - Nominal Operations	✓	ME-017		
3.3.6.19B	6.4.4.3.3B	3.12.4.3.3B	Ease of Disconnect - ORU Replacement Operations	✓	ME-017		
3.3.6.20	6.4.4.3.4	3.12.4.3.4	Indication of Pressure/Flow	N/A	ME-050		No fluids
3.3.6.21	6.4.4.3.5	3.12.4.3.5	Self Locking	✓	ME-017		
3.3.6.22A	6.4.4.3.6A	3.12.4.3.6A	Connector Arrangement - Space between Connectors and Adjacent Obstructions	✓	ME-018		
3.3.6.22B	6.4.4.3.6B	3.12.4.3.6B	Connector Arrangement - Space between Connectors in a Row	✓	ME-018		
3.3.6.23	6.4.4.3.7	3.12.4.3.7	Arc Containment	✓	EL-026		
3.3.6.24	6.4.4.3.8	3.12.4.3.8	Connector Protection	✓	ME-019		
3.3.6.25	6.4.4.3.9	3.12.4.3.9	Connector Shape	✓	ME-019		
3.3.6.26	6.4.4.3.10	3.12.4.3.10	Fluid and Gas Line Connectors	N/A	FD-001		No fluid/gas lines
3.3.6.27	6.4.4.3.11A	3.12.4.3.11A	Alignment Marks or Guide Pins	✓	ME-020		
3.3.6.28A	6.4.4.3.12A	3.12.4.3.12A	Coding - Unique to Connection	✓	ME-020		
3.3.6.28B	6.4.4.3.12B	3.12.4.3.12B	Coding - Visible	✓	ME-020		
3.3.6.29	6.4.4.3.13	3.12.4.3.13	Pin Identification	✓	EL-007		
3.3.6.30	6.4.4.3.14	3.12.4.3.14	Orientation	✓	ME-020		
3.3.6.31A	6.4.4.3.15A	3.12.4.3.15A	Hose/Cable Restraints - Loose Ends	✓	ME-022		
3.3.6.31B	6.4.4.3.15B	3.12.4.3.15B	Hose/Cable Restraints - Clamps	✓	ME-022		
3.3.6.31D	6.4.4.3.15D	3.12.4.3.15D	Hose/Cable Restraints - Loose Cables	✓	ME-022		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.32	6.4.4.4.1	3.12.4.4.1	Non-Threaded Fasteners Status Indication	✓	ME-023		
3.3.6.33	6.4.4.4.2	3.12.4.4.2	Mounting Bolt/Fastener Spacing	✓	ME-024		
3.3.6.34	6.4.4.4.3	3.12.4.4.4A	Multiple Fasteners	✓	ME-025		
3.3.6.35	6.4.4.4.4	3.12.4.4.5	Captive Fasteners	✓	ME-026		
3.3.6.36A	6.4.4.4.5A	3.12.4.4.6A	Quick Release Fasteners - One turn max	✓	ME-026		
3.3.6.36B	6.4.4.4.5B	3.12.4.4.6B	Quick Release Fasteners - Positive Locking	✓	ME-026		
3.3.6.37	6.4.4.4.6	3.12.4.4.7	Threaded Fasteners	✓	ME-026		
3.3.6.38A-C	6.4.4.4.7A-C	3.12.4.4.8A-C	Over Center Latches	N/A	ME-027		No over-center latches
3.3.6.39	6.4.4.4.8	3.12.4.4.9	Winghead Fasteners	N/A	ME-026		No winghead fasteners
3.3.6.40A	6.4.4.4.9A	3.12.4.4.11A	Fastener Head Type - On-Orbit Crew Actuation	✓	ME-028		
3.3.6.40B	6.4.4.4.9B	3.12.4.4.11B	Fastener Head Type - Smooth Surface	✓	ME-028		
3.3.6.40C	6.4.4.4.9C	3.12.4.4.11C	Fastener Head Type - Slotted Fasteners	✓	ME-028		
3.3.6.41	6.4.4.4.10	3.12.4.4.12	One-Handed Actuation	✓	ME-029		
3.3.6.43	6.4.4.4.12	3.12.4.4.14	Access Holes	✓	ME-024		
3.3.6.44	6.4.5.1	3.12.5.1	Controls Spacing Design Requirements	✓	ME-030		
3.3.6.45.1A-G	6.4.5.2.1A-G	3.12.5.2.1A-G	Protective Methods	✓	ME-031		
3.3.6.45.2	6.4.5.2.2	3.12.5.2.2	Noninterference	✓	ME-030		
3.3.6.45.3	6.4.5.2.3	3.12.5.2.3	Dead-Man Controls	N/A	Safety		No dead-man controls
3.3.6.45.4	6.4.5.2.4	3.12.5.2.4	Barrier Guards	✓	ME-030		
3.3.6.45.5	6.4.5.2.5	3.12.5.2.5	Recessed Switch Protection	N/A	ME-031		No recessed or rotary switches
3.3.6.46	6.4.5.2.7	3.12.5.2.7	Position Indication	N/A	ME-032		No covers in design
3.3.6.47	6.4.5.2.8	3.12.5.2.8	Hidden Controls	N/A	ME-031		No hidden controls
3.3.6.48	6.4.5.2.9	3.12.5.2.9	Hand Controllers	N/A	ME-031		No hand controllers
3.3.6.49A-E	6.4.5.3A-E	3.12.5.3A-E	Valve Controls	N/A	ME-033		No valves in design
3.3.6.50	6.4.5.4	3.12.5.4	Toggle Switches	✓	ME-034		
3.3.6.51	6.4.6	3.12.6	Restraints and Mobility Aids	✓	ME-035		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.51.1A	6.4.6.1A	3.12.6.1A	Stowage Drawer Contents - Restraints	✓	ME-036		
3.3.6.51.1B	6.4.6.1B	3.12.6.1B	Stowage Drawer Contents - Restraints	✓	ME-036		
3.3.6.51.1C	6.4.6.1C	3.12.6.1C	Stowage Drawer Contents - Restraints	✓	ME-036		
3.3.6.51.2A	6.4.6.2A	3.12.6.2A	Stowage and Equipment Drawers/Trays	✓	ME-027		
3.3.6.51.2B	6.4.6.2B	3.12.6.2B	Stowage and Equipment Drawers/Trays	✓	ME-027		
3.3.6.51.3	6.4.6.3	3.12.6.3	Captive Parts	✓	ME-036		
3.3.6.51.4.1	6.4.6.4.1	3.12.6.4.1	Handles and Restraints	N/A	ME-037		All portable equipment can be grasped with one hand.
3.3.6.51.4.2	6.4.6.4.2	3.12.6.4.3	Handle Location/Front Access	N/A	ME-037		No handles in design.
3.3.6.51.4.3	6.4.6.4.3	3.12.6.4.4	Handle Dimensions	N/A	ME-037		No handles in design.
3.3.6.51.4.4A-C	6.4.6.4.4A-C	3.12.6.4.5A-C	Non-Fixed Handles Design Requirements - Stop Position	N/A	ME-037		No non-fixed handles
3.3.6.52B	6.4.9.1B	3.12.9.1B	Electrical Hazards - Exposure hazard exceeds threshold for shock	✓	EL-041		
3.3.6.52C	6.4.9.1C	3.12.9.1C	Electrical Hazards - Exposure hazard exceeds threshold for shock and threshold of let-go profile	✓	EL-041		
3.3.6.52D	6.4.9.1D	3.12.9.1D	Electrical Hazards - Two dependent controls provided	✓	EL-041		
3.3.6.52E	6.4.9.1E	3.12.9.1E	Electrical Hazards - Three independent hazard controls	✓	EL-041		
3.3.6.52.1A	6.4.9.1.1A	3.12.9.1.1	Mismatched - Reversed Connection	✓	ME-019		
3.3.6.52.1B	6.4.9.1.1B	3.12.9.1.1	Mismatched - Blind Connections	✓	ME-019		
3.3.6.52.1C	6.4.9.1.1C	3.12.9.1.1	Mismatched - Mismating	✓	ME-019		
3.3.6.52.1D	6.4.9.1.1D	3.12.9.1.1	Mismatched - Minimizing Equipment Risk	✓	ME-019		
3.3.6.52.2.1	6.4.9.1.2.1	3.12.9.1.4.1	Device Accessibility	✓	EL-013		
3.3.6.52.2.2	6.4.9.1.2.2	3.12.9.1.4.2	Extractor-Type Fuse Holder	N/A	EL-013		No fuse holders
3.3.6.52.2.3	6.4.9.1.2.3	3.12.9.1.4.3	Overload Protection Location	✓	EL-013		
3.3.6.52.2.4	6.4.9.1.2.4	3.12.9.1.4.4	Overload Protection Identification	✓	EL-013		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.52.2.5	6.4.9.1.2.5	3.12.9.1.4.5	Automatic Restart Protection	✓	EL-013		
3.3.6.53	6.4.9.10	3.12.9.10	Audio Displays	N/A	ME-044		No audio displays.
3.3.6.54	6.4.9.11	3.12.9.12	Egress	✓	Safety		
3.3.8.1.1A	6.1.1.3B	3.1.1.3B	Structural Design Requirements - Positive Safety Margins for On-orbit Loads	✓	ST-001		
3.3.8.1.1B	6.1.1.3D	3.1.1.3D	Structural Design Requirements - Crew Induced Load Requirements	✓	ST-002		
3.3.8.1.2	6.1.1.5	3.1.1.5A	Safety Critical Structures Requirements	✓	ST-001 ST-002 ST-003 ST-004 ST-008 ST-009 ST-010		
3.3.8.1.3	6.1.1.4C	3.1.1.4C	Modal Frequency	✓			
3.3.8.1.4A	6.1.1.3A	3.1.1.3A	Launch and Landing Loads – Margins of Safety	✓	ST-001		
3.3.8.1.4B	6.1.1.3E	3.1.1.3E	Launch and Landing Loads - Random Vibration	✓	ST-001		
3.3.8.1.4C	6.1.1.3F	3.1.1.3F	Launch and Landing Loads – Load Factors	✓	ST-001		

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

HRD Section	LS-71000 Section	Requirement	Applicable	Verification Method	Comments
3.2.1.1A		Attach to existing ISS hardware without modification.	✓	I, T	Inspect Drawings, Fit Check
3.2.1.1B		Have minimal activities required to attach the MARES Main Box and VIF.	✓	I, D	Inspect Drawings, Demonstrate attachment activities
3.2.1.1C		Minimize the MARES envelope when in a stowed configuration while allowing deployment in a manner conducive to operations.	✓	D	Demonstrate stowed configuration of MARES/MIDAS
3.2.1.1D		Provide stowage capability for all MARES hardware.	✓	D	Demonstrate MARES use in deployed configuration
3.2.1.1E		Not impede stowing of MARES hardware in the free space around the MARES mounting structure.	✓	D	Demonstrate stowage logistics of free rack space
3.2.1.1F		Provide cables to attach the MARES to either the UIP or the SUP/UOP.	✓	T	Perform interface test with as-built cables.
3.2.1.1G		MIDAS shall provide a logistical launch plan for all MARES hardware not launched on UF3.	✓	D	Demonstrate plans
3.2.2.2.1		Stowed Envelope	✓	I	Inspect drawings
3.2.2.2.2.2		Deployed Envelope Dimensions	✓	I	Inspect drawings
3.2.2.2.3		Launch Envelope	✓	I	Inspect drawings
3.2.3A	7.2	Reliability, Quality, and Non-Conformance Reporting	✓	I	TPS, DR, FIAR System in place
3.2.3B	7.3.1	Reliability, Quality, and Non-Conformance Reporting	✓	I	TPS, DR, FIAR System in place
3.2.3.C1	7.3.2.1	Reliability, Quality, and Non-Conformance Reporting	✓	I	TPS, DR, FIAR System in place
3.2.3.C2	7.3.2.2	Reliability, Quality, and Non-Conformance Reporting	✓	I	TPS, DR, FIAR System in place
3.2.3.C3	7.3.2.3	Reliability, Quality, and Non-Conformance Reporting	✓	I	TPS, DR, FIAR System in place

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

I – Inspection D – Demonstration A- Analysis T - Test

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

HRD Section	LS-71000 Section	Requirement	Applicable	Verification Method	Comments
3.2.3.C4	7.3.2.4	Reliability, Quality, and Non-Conformance Reporting	✓	I	TPS, DR, FIAR System in place
3.2.3.1		Failure Propagation	✓	I, A	
3.2.3.2	3.1.1	Useful Life	✓	A	Review FMEA, LLIL
3.2.3.2.1		Operational Life (Cycles)	✓	A	Review FMEA, LLIL
3.2.3.2.2		Shelf Life	✓	A	
3.2.3.2.3		Limited Life	✓	A	Review LLIL
3.2.6.1		Launch and Landing	N/A	N/A	
3.2.7.2.11.1		MIDAS Trip Requirements Summary	✓	**TBD**	
3.3.1.1.1.1A		Russian Materials Usage Agreement	✓		
3.3.1.1.1.1B		Russian Materials Usage Agreement	✓		
3.3.1.9C		Locking Wires	N/A		No locking wires
3.3.3	7.3.1	Workmanship	✓	I	Inspection at assembly, release of drawings
3.3.6.2.1A	6.4.3.5.1	Interior Color - Rack Mounted Equipment - Front Panel Color	✓	I	HRF ED-001A, inspect drawings
3.3.6.2.1B	6.4.3.5.1	Interior Color - Rack Mounted Equipment - Front Panel Finish	✓	I	HRF ED-001A, inspect drawings
3.3.6.2.1C	6.4.3.5.1	Interior Color - Rack Mounted Equipment - Latches	✓	I	HRF ED-001A, inspect drawings
3.3.6.2.2A	6.4.3.5.2A	Interior Color - Stowed/Deployable Equipment - COTS	✓	I	HRF ED-001A, inspect drawings
3.3.6.2.2B	6.4.3.5.2B	Interior Color - Stowed/Deployable Equipment - Repackaged	✓	I	HRF ED-001A, inspect drawings
3.3.6.2.3	6.4.3.5.3	Soft Goods - Color	✓	I	HRF ED-001A, inspect drawings

NOTE: Fill in rows for Section 3.2.7.3.6 per LS-71020 Appendix A.

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

I – Inspection D – Demonstration A- Analysis T - Test

APPENDIX D

ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRICES

APPENDIX D

{In coordination with HRF SE&I and JSC/NT3, determine the set of Qualification and Acceptance tests which are required for this equipment. Highlight the required tests in Tables D-1, D-2 and D-3. Show required testing for **MIDAS** *with a "✓" in bold type in the appropriate block. Recommended testing is shown for various equipment component categories in these tables and is encoded with a "✓". In the completed table, replace the generic "Component" at the top of each column with the specific equipment item names. Delete "Component" columns that are not applicable to the equipment items described by this HRD. The completed table will then have a column for each category of equipment to be tested and will be specific to the equipment for which this HRD is written.}*

TABLE D-1. ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRIX

HRD Section	HRD Verification Section	LS-71000 Section	Requirement	Applicable	Comments
3.4.1A	4.3.1.1, 4.3.1.2	5.4.1.1.6.1 and 5.4.1.1.6.2	Thermal Environment Compatibility	✓	
3.4.1B	4.3.1.1, 4.3.1.2	5.4.1.1.6.1 and 5.4.1.1.6.2	Thermal Environment Compatibility	✓	
3.4.2	4.3.2		Vibration and Sine Sweep	✓	
3.4.3	4.3.3	5.4.1.3.4	Functional Acceptance	✓	
3.4.4	4.3.4	5.4.1.1.10	EEE Parts Control, Selection, and Burn-in	✓	
3.4.5	4.3.5	5.4.1.1.8	Flammability	✓	
3.4.6	4.3.6	5.4.1.1.9	Offgassing	✓	
3.4.7	4.3.7	5.4.1.1.4	Shock	N/A	Not rack mounted equipment
3.4.8	4.3.8	5.4.1.1.5	Bench Handling	N/A	Not stowed equipment
3.4.9	4.3.9	5.4.1.1.1	Payload Mass	✓	
3.4.10	4.3.10	5.4.1.2.1	Electromagnetic Compatibility	✓	

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

TABLE D-1. ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRIX (Cont'd)

HRD Section	HRD Verification Section	LS-71000 Section	Requirement	Applicable	Comments
3.4.11	4.3.11	5.4.1.1.7	Acoustic Noise	N/A	
3.4.12.1	4.3.12.1	5.4.1.1.11.1	Safety Critical Structure Dimensional Check	✓	
3.4.12.2	4.3.12.2	5.4.1.1.11.2	Safety Critical Structure Material Certification	✓	
3.4.13	4.3.13	5.4.1.3.1	Software Acceptance	N/A	No software
3.4.14	4.3.14	5.4.1.3.2	Pre-Delivery Acceptance	✓	
3.4.15	4.3.15	5.4.1.3.3	Pre-Installation	✓	

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

TABLE D-2. NON-CRITICAL HARDWARE QUALIFICATION TEST REQUIREMENTS

Component / Type Test	Example Electronic Equipment	Example Mechanical Equipment	Example Battery	**MIDAS**	Part Number	Part Number	Part Number	Part Number
Thermal Cycling 7.5 Cycles	✓	✓	✓	✓				
Qualification for Acceptance Vibration	✓	✓	✓	N/A				
Flammability	✓	✓	✓	✓				
Offgassing	✓	✓	✓	✓				
Bench Handling	✓	✓	✓	N/A				
Payload Mass Control Plan	✓	✓	✓	✓				
EMI/EMC Control Plan	✓		✓	✓				
Acoustic Noise Control Plan	✓	✓		N/A				
EEE Parts Screening	✓	✓	✓	✓				
EEE Parts Control	✓	✓	✓	✓				

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

TABLE D-3. NON-CRITICAL HARDWARE ACCEPTANCE TEST REQUIREMENTS

Component / Type Test	Example Electronic Equipment	Example Mechanical Equipment	Example Battery	**MIDAS**	Part Number	Part Number	Part Number	Part Number
Thermal Cycling 1½ Cycles	✓	✓	✓	✓				
Acceptance Vibration	✓	✓	✓	N/A				
Functional	✓	✓	✓	✓				
Burn-in	✓	✓	✓	✓				
Pre-Delivery Acceptance Functional	✓	✓	✓	✓				

✓ - Requirement is applicable E - Exception N/A - Requirement is not applicable

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX

APPENDIX E

	SECTION III			
		JHB 8080.5 DESIGN GUIDANCE SECTION		
No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	GENERAL			
	G-1	Equipment Accessibility for Maintenance	✓	Inspect drawing, design, and hardware
	G-2	Separation of Redundant Equipment	N/A	N/A to MIDAS design
	G-3	Systems Checkout Provisions	✓	Inspect drawing, design, and hardware
	G-4	Protection of Spacecraft Electrical and Mechanical Systems from Debris	✓	Inspect drawing and design
	G-5	Interior Design of Spacecraft for Cleanliness	N/A	N/A to MIDAS design
	G-6	Redundancy Requirements	N/A	N/A to MIDAS design
	G-7	Time Displays	N/A	N/A to MIDAS design
	G-8	Redundant Paths - Verification of Operation	N/A	N/A to MIDAS design
	G-9	Shatterable Material - Exclusion From Habitable Compartment	✓	Inspect H/W Item drawing and design
	G-10	Control of Limited- Life Components	✓	Review Limited Life Items List (LLIL)
	G-11	Procurement Document Identification for Manned Space Flight Vehicle Items	✓	Audit procurement documents as necessary
	G-12	Application of Previous Qualification Tests	N/A	MIDAS is new design
	G-13	Shipping and Handling Protection for Space Flight Hardware	✓	
	G-14	Identification and Classification of Flight and Non-flight Equipment	✓	
	G-15	Equipment Failure - Verification of Flight Readiness	✓	Discrepancy Report (DR) and Failure Investigation Analysis Report (FIAR) Systems in place
	G-16	Operating Limits on Temperature - Controlled Equipment	✓	
	G-17	Separate Stock for Space Flight Parts and Materials	✓	Reference assembly TPSs and ADP for evidence of traceability

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	G-18	Safety Precautions - Test and Operating Procedures	✓	Audit Test Procedures
	G-19	Special Processes - Identification of Drawings	✓	Review Drawings. Applicable to Class I flight equipment only.
	G-20	Spacecraft Equipment - Protection from System Liquids	N/A	The MIDAS contains no liquids.
	G-21	Spacecraft Equipment - Moisture Protection	N/A	N/A to MIDAS design.
	G-22	Parts Identification	✓	Reference assembly TPSs and ADP for evidence of traceability
	G-23	Pressure Garment Wiring - Ignition of Materials by Electrical Current	N/A	N/A to MIDAS design
	G-24	GSE and Airborne Support Equipment Protective Devices	✓	Review hardware item design and drawings
	G-25	Thermal Design and Analysis - Thermal Parameters	✓	
	G-26	Internally Generated Radiation	N/A	The MIDAS contains no radiation generating parts.
	G-27	Fire Control	✓	
	G-28	Sealing - Solid Propellant Rocket Motors	N/A	The MIDAS is not a rocket motor.
	G-29	Reentry Propulsion Subsystem In-Flight Test	N/A	N/A to MIDAS design
	G-30	Switch Protection Devices	✓	
	G-31	Detachable Crew-Operated Tools - Restriction in Spacecraft	N/A	The MIDAS has no detachable tools.
	G-32	Measurement Systems That Display Flight Information to the Crew - Indication of Failure	N/A	The MIDAS has no displays.
	G-33	Surface Temperatures	✓	
	G-34	Extravehicular Activity Electronic Connectors	N/A	The MIDAS is IVA equipment.
	G-35	Enclosure Panels External to the Habitable Modules	N/A	The MIDAS is IVA equipment.

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	G-36	Thermal Blankets - Extravehicular Activity	N/A	The MIDAS is IVA equipment.
	G-37	Verification of Adequate External Visibility	N/A	The MIDAS is IVA equipment.
	G-38	Pressurization or Repressurization - Precluding Ingress of Undesirable Elements	N/A	The MIDAS is not a pressurization, repressurization, or ventilation system.
	G-39	Lightning Protection Design	N/A	MIDAS is not a spacecraft.
	G-40	Radioactive Luminescent Devices	N/A	MIDAS contains no luminescent devices.
	G-41	Acoustic Noise Criteria	N/A	No acoustic sources in MIDAS
	G-42	Solar Wind Environment	N/A	N/A to MIDAS design
	G-43	Centralized Subsystem Controls	✓	
	G-44	Attitude Control Authority	N/A	The MIDAS does not control attitude.
	G-45	Solid Propellant Rocket Motors - Ignition Capability with Unsealed Nozzle	N/A	The MIDAS is not a rocket motor.
	G-46	Separation Sensing System - Structural Deformation	N/A	The MIDAS is not a separation sensing system.
	G-47	Gyroscopes - Verification of Rotational Speed or Drift Rate	N/A	MIDAS contains no gyroscopes
	G-48	Onboard Experiments - Required Pre-installation Checklist	✓	Review procedures
	G-49	Temperature and Pressure Monitoring Requirements of Hydrogen Peroxide Systems	N/A	N/A to MIDAS design
	G-50	Direct Procurement of Parts	✓	Audit Procurement Documentation
	G-51	Flight Hardware - Restriction on Use for Training	✓	Controlled through TPSs
	G-52	Reuse of Flight Hardware	✓	
	ELECTRICAL			
	E-1	Mating Provisions for Electrical Connectors	✓	
	E-2	Protection of Severed Electrical Circuits	N/A	The MIDAS does not contain circuits that are to be severed during mission events.

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	E-3	Electrical and Electronic Devices - Protection from Reverse Polarity and/or Other Improper Electrical Inputs	✓	
	E-4	Electrical Connectors - Moisture Protection	✓	
	E-5	Electrical Connectors - Pin Assignment	✓	
	E-6	Corona Suppression	✓	
	E-7	Tantalum Wet Slug Capacitors - Restriction on Use	✓	Review Hardware drawings and design
	E-8	Electrical and Electronic Supplies and Loads - Verification Tests	✓	Review TPSs
	E-9	Electrical Circuits - De-energizing Requirements	✓	Review Drawings, Design, and Test Procedures
	E-10	Cleaning of Electrical and Electronic Equipment	✓	
	E-11	Protective Covers or Caps for Electrical Receptacles and Plugs	✓	
	E-12	Electrical Connectors - Disconnection for Troubleshooting and Bench Testing	✓	
	E-13	Bioinstrumentation Systems - Crew Electrical Shock Protection	N/A	The MIDAS is not a bioinstrumentation system..
	E-14	Electrical Wire Harness - Dielectric Tests	✓	Ref. Assembly TPS
	E-15	Electrical Power Distribution Circuits - Overload Protection	✓	Review hardware item design and drawings
	E-16	Testing Protective Devices for Solid-State Circuits	✓	
	E-17	Electrical and Electronic Piece Parts - Closure Construction	✓	
	E-18	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)	N/A	The MIDAS does not interface with the launch vehicle engine.
	E-19	Equipment Design - Power Transients	✓	
	E-20	Control of Electrostatic Discharge for Electronic Parts and Assemblies	✓	

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	E-21	Electrical Connectors	✓	
	E-22	Ionizing Radiation Effects	✓	
	E-23	Transistors - Selection of Types	✓	Review hardware item design and drawings
	E-24	Electrical Wire and Cable Acceptance Tests	✓	Review Assembly TPSs
	FLUIDS			
	F-1	Flow Restriction Requirements - Pressurized Sources	N/A	MIDAS contains no fluids or fluid systems.
	F-2	Moisture Separators in a Zero-Gravity Environment	N/A	MIDAS contains no fluids or fluid systems.
	F-3	Service Points - Positive Protection From Interchangeability of Fluid Service Lines	N/A	MIDAS contains no fluids or fluid systems.
	F-4	Ground Service Points - Fluid Systems	N/A	MIDAS contains no fluids or fluid systems.
	F-5	Fluid Lines - Separation Provisions	N/A	MIDAS contains no fluids or fluid systems.
	F-6	Temperature and Pressure Monitoring Requirements for Potentially Hazardous Reactive Fluids	N/A	MIDAS contains no fluids or fluid systems.
	F-7	Capping of Servicing and Test Ports	N/A	MIDAS contains no fluids or fluid systems.
	F-8	Fluid System Components Whose Function is Dependent on Direction of Flow - Protection Against Incorrect Installation	N/A	MIDAS contains no fluids or fluid systems.
	F-9	Spacecraft Venting - Induced Perturbing Forces	N/A	MIDAS contains no fluids or fluid systems.
	F-10	Nozzles and Vents - Protection Prior to Launch	N/A	MIDAS contains no fluids or fluid systems.
	F-11	Fluid Supplies - Verification Tests	N/A	MIDAS contains no fluids or fluid systems.
	F-12	Protection of Pressurized Systems from Damage Due to Pressurant Depletion - GSE and Airborne Support Equipment	N/A	MIDAS contains no fluids or fluid systems.
	F-13	Crew Cabin Module Pressure - Venting Restriction	N/A	MIDAS contains no fluids or fluid systems.

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	F-14	Crew Cabin Module Ventilating Fans - Protection from Debris	N/A	MIDAS contains no fluids or fluid systems.
	F-15	Separation of Hypergolic Reactants	N/A	MIDAS contains no fluids or fluid systems.
	F-16	Fluid Line Installation	N/A	MIDAS contains no fluids or fluid systems.
	F-17	Cleanliness of Flowing Fluids and Associated Systems	N/A	MIDAS contains no fluids or fluid systems.
	F-18	Pressure Relief Valves - Standardization of Functional Testing	N/A	MIDAS contains no fluids or fluid systems.
	F-19	Protection for Tubing, Fittings, and Fluid System Components - Flight Hardware and Associated Equipment	N/A	MIDAS contains no fluids or fluid systems.
	F-20	Fluid Systems - Cleanliness	N/A	MIDAS contains no fluids or fluid systems.
	F-21	Purge Gases - Temperature and Humidity Requirements	N/A	MIDAS contains no fluids or fluid systems.
	F-22	Pressure Garments - Protection Against Failure Propagation	N/A	MIDAS contains no fluids or fluid systems.
	F-23	Qualification Fluid	N/A	MIDAS contains no fluids or fluid systems.
	F-24	Fluid Systems - Design for Flushing and Draining	N/A	MIDAS contains no fluids or fluid systems.
	F-25	Toxicity - Fluids Contained in Systems in the Crew Compartment	N/A	MIDAS contains no fluids or fluid systems.
	F-26	Atmospheric Pressure and Composition Control	N/A	MIDAS contains no fluids or fluid systems.
	F-27	Liquid or Gas Containers - Verification of Contents	N/A	MIDAS contains no fluids or fluid systems.
	F-28	Use of Halogen Method for Coolant System Leak Detection	N/A	MIDAS contains no fluids or fluid systems.
	F-29	Filter Protection of Active Fluid Components	N/A	MIDAS contains no fluids or fluid systems.
	F-30	Pressure Relief for Pressure Vessels	N/A	MIDAS contains no fluids or fluid systems.

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	MATERIALS AND PROCESSES			
	M/P-1	Material Selection, Review, and Drawing Sign-off	✓	Review Hardware Item Material Review Cert.
	M/P-2	Flammability of Wiring Material	✓	Review Hardware Item Material Review Cert.
	M/P-3	Toxicity of Materials Used in Crew Compartments - Wire Insulation, Ties, Identification Marks, and Protective Coverings	✓	Review Hardware Item Material Review Cert.
	M/P-4	Metals and Metal Couples - Restriction on Use	✓	Review Hardware Item Material Review Cert.
	M/P-5	Solutions Which Contain Ethylene Glycol - Requirements for Silver Chelating Agent	N/A	MIDAS contains no ethylene glycol.
	M/P-6	Toxicity - Requirements for Nonmetallic Materials Proposed for Use Within Crew Compartment	✓	Review Hardware Item Material Review Cert.
	M/P-7	Material Detrimental to Electrical Connectors	✓	Review Hardware Item Material Review Cert.
	M/P-8	Leak Detectors - Wetting Agents	N/A	MIDAS design needs no leak detection.
	M/P-9	Breathing Systems - Requirement to Test for Mercury Contamination	N/A	MIDAS is not a breathing system.
	M/P-10	Liquid Locking Compounds, Restrictions, and Controls	✓	
	M/P-11	Pressure Vessel Documentation	N/A	MIDAS contains no pressure vessels.
	M/P-12	Multi-Layer Blanket Bake-Out	N/A	MIDAS contains no multi-layer thermal blankets.
	M/P-13	Pressure Vessel Design	N/A	MIDAS contains no pressure vessels.
	M/P-14	Silicate Ester Coolant System Design	N/A	MIDAS is not a coolant system
	M/P-15	Mercury - Restriction on Use	✓	N/A to MIDAS design.
	M/P-16	Restriction on Coatings for Areas Subject to Abrasion	✓	N/A to MIDAS design.
	M/P-17	Radiographic Inspection of Brazed and Welded Tubing Joints	N/A	MIDAS contains no tubing joints.
	M/P-18	Etching Fluorocarbon Insulated Electrical Wire	✓	

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	M/P-19	Spacecraft Material - Restriction on Use of Polyvinyl Chloride	✓	N/A to MIDAS design.
	M/P-20	Titanium or its Alloys - Prohibited Use With Oxygen	✓	N/A to MIDAS design.
	M/P-21	Beryllium - Restricted Use Within Crew Components	✓	N/A to MIDAS design.
	M/P-22	Brazed Joints - Identification Marks	N/A	MIDAS contains no brazed joints.
	M/P-23	Pressure Vessels - Materials Compatibility and Vessel Qualifications Tests	N/A	MIDAS contains no pressure vessels.
	M/P-24	Cadmium - Restriction on Use	✓	N/A to MIDAS design.
	M/P-25	Pressure Vessels - Nondestructive Evaluation Plan	N/A	MIDAS contains no pressure vessels.
	M/P-26	Repair of Sandwich - Type Structures	N/A	MIDAS contains no sandwich-type structures
	MECHANICAL AND STRUCTURAL			
	M/S-1	Equipment Containers - Design For Rapid Spacecraft Decompression	✓	Review drawings and design, Test if necessary
	M/S-2	Alignment of Mechanical Systems	✓	
	M/S-3	Wire Bundles - Protective Coating	✓	
	M/S-4	Hatches - Repeated Use	N/A	MIDAS contains no hatches.
	M/S-5	Threaded Fittings - Restrictions on Release of Particles and Foreign Materials	✓	
	M/S-6	Exposed Sharp Surfaces or Protrusions	✓	
	M/S-7	Windows and Glass Structure	N/A	MIDAS contains no windows or glass.
	M/S-8	Penetration of Inhabited Spacecraft Compartments	N/A	MIDAS is not a spacecraft compartment.
	M/S-9	Mechanisms	✓	
	M/S-10	Functional Doors That Operate in Flight	N/A	MIDAS contains no doors.
	M/S-11	Meteoroid Protection Levels for Structures	N/A	MIDAS is a payload

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No.	**Standard #**	**Abbreviated Requirement**	**App.**	**Comments**
	M/S-12	Spacecraft Recovery Hoist Loops	N/A	N/A to MIDAS design.
	M/S-13	Lifting and Hoisting GSE Identification	N/A	N/A to MIDAS design
	M/S-14	Structural Analysis	✓	
	M/S-15	Stainless Steel Tubing - Method of Joining	N/A	MIDAS contains no stainless steel tubing.
	M/S-16	Pressure Vessels - Negative Pressure Damage	N/A	MIDAS contains no pressure vessels.
	PYROTECHNIC			
	P-1	Explosive Devices - Arming and Disarming	N/A	MIDAS contains no pyrotechnics.
	P-2	Pyrotechnic Devices - Preflight Verification Tests at Launch Sites	N/A	MIDAS contains no pyrotechnics.
	P-3	Wire Splicing	N/A	MIDAS contains no pyrotechnics.
	P-4	Explosive Devices - Packaging Material	N/A	MIDAS contains no pyrotechnics.
	P-5	Explosive Devices - Identification Requirements	N/A	MIDAS contains no pyrotechnics.
	P-6	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridge Wire Initiators	N/A	MIDAS contains no pyrotechnics.
	P-7	Explosive Devices - Color Coding Requirements	N/A	MIDAS contains no pyrotechnics.